Item 2 – Background
(Chris Foe's Presentation)

Revised Agenda

Item #1 Introductions & Announcements

Item #2 Background

- Delta Nutrient Study Plan (Chris Foe)
- San Francisco Bay Nutrient Studies (David Senn)
- Delta RMP Nutrient Monitoring Subcommittee (Thomas Jabusch)
- Statewide Nutrient Numerical Endpoint Program (Martha Sutula)

Item #3 Lunch Break

Item #4 Topic specific issues

- Overview (Chris Foe)
- Shifts in abundance and composition of algal community (Chris Foe)
- Cyanobacteria white paper outline (Mine Berg)
- Rooted and Floating Macrophyte white paper outline (Kathy Boyer)

Item #5 Wrap up

Delta Stewardship Council

Recommendation WQ R8

- The State Water Resources Control Board should complete development of the proposed policy for nutrients for inland surface waters of the State of California by January 1, 2014.
- The State Water Resources Control Board and the San Francisco Bay and Central Valley Regional Water Quality Control Boards should prepare and begin implementation of a study plan for the development of objectives for nutrients in the Delta and Suisun Marsh by January 1, 2014. Studies needed for development of Delta and Suisun Marsh nutrient objectives should be completed by January 1, 2016. The water boards should adopt and begin implementation of nutrient objectives, either narrative or numeric, where appropriate, for the Delta and Suisun Marsh by January 1, 2018

Recommendation WQ R9

- The State Water Resources Control Board and Regional Water Quality Control Boards should work collaboratively with the California Department of Water Resources, California Department of Fish and Wildlife, and other agencies and entities that monitor water quality in the Delta to develop and implement a Delta Regional Monitoring Program that will be responsible for coordinating monitoring efforts so Delta conditions can be efficiently assessed and reported on a regular basis.

Potential nutrient related impairments

- Increase in the abundance & distribution of macrophytes.
- Increase in the frequency & magnitude of cyanobacteria blooms.
- Shifts in abundance and composition of algal community
- Low dissolved oxygen in back sloughs

2014 Delta Strategic Plan

Chris Foe

7 February 2014

Nutrient Study Plan

Tasks & Deliverables

-Spring 2014 Assemble Technical Advisory Committee & Stakeholder Advisory Group to develop study plans.

-Winter 2014 Present research plan to Water Board & Delta Stewardship Council.

-**2015 and Beyond** Solicit external funding & implement plans.

-**Spring 2018** Staff prepare white paper for Water Board assessing whether nutrients negatively impact beneficial uses. Seek direction on next steps

Revised Agenda

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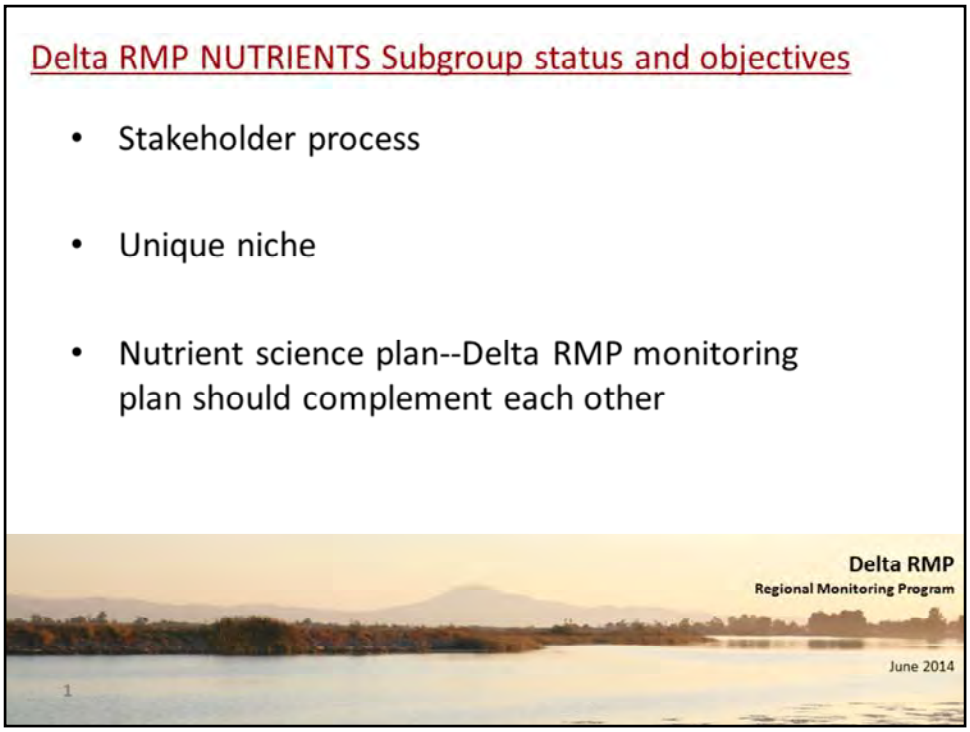
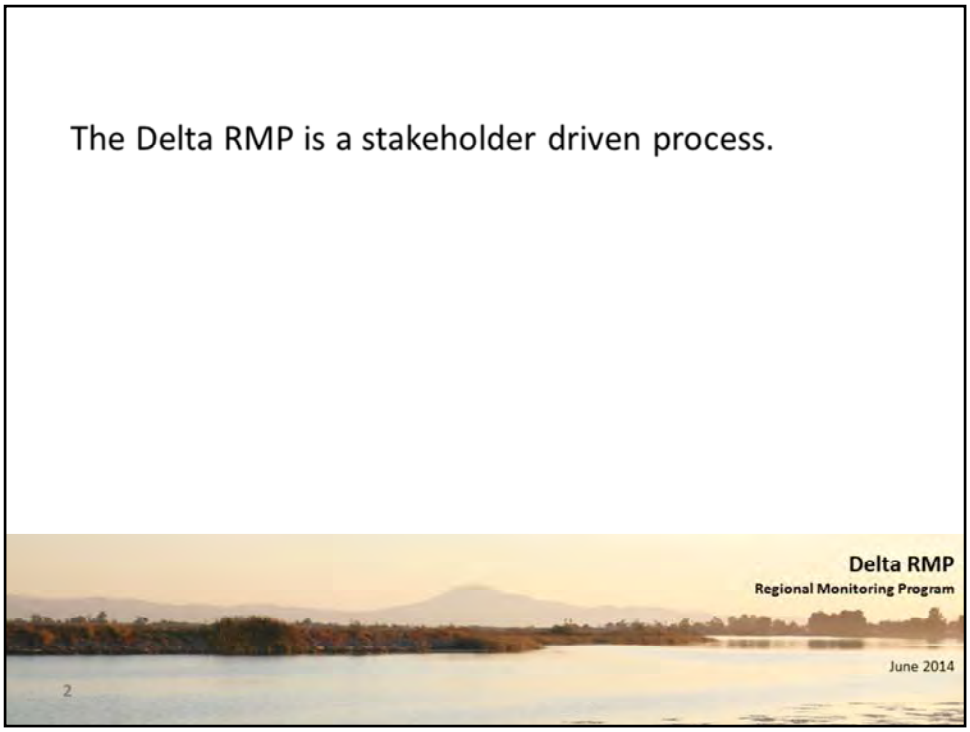
Item #5 Wrap up

Item 2 – Background
Delta RMP
(Thomas Jabusch's Presentation)



Major question: How could the IEP Nutrient Subcommittee and Delta RMP Nutrient Subcommittee work together?



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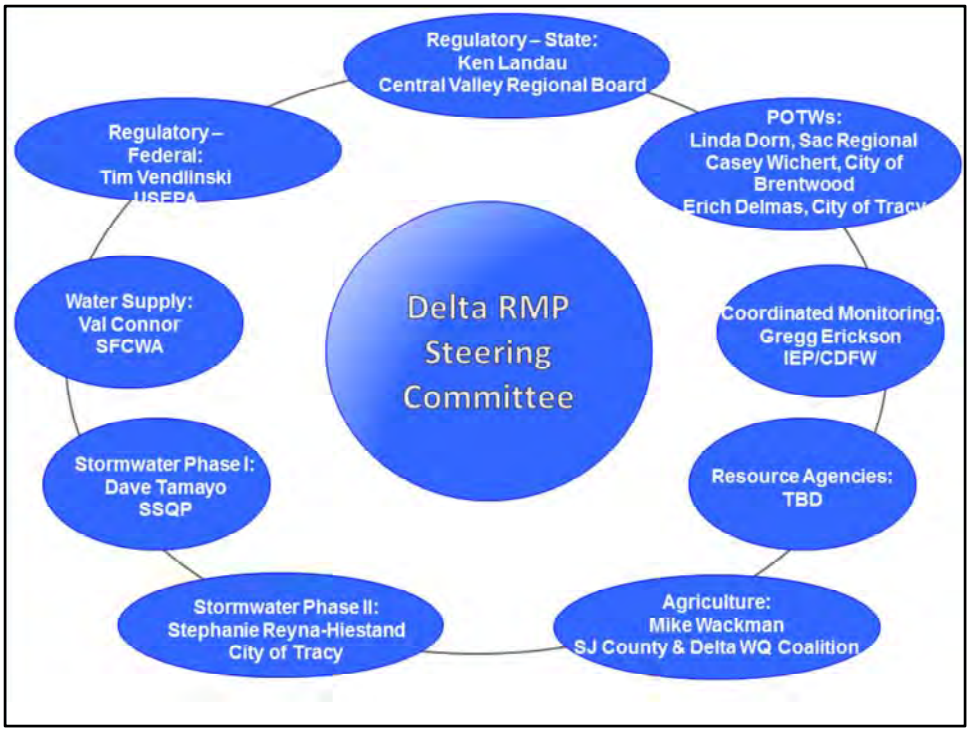
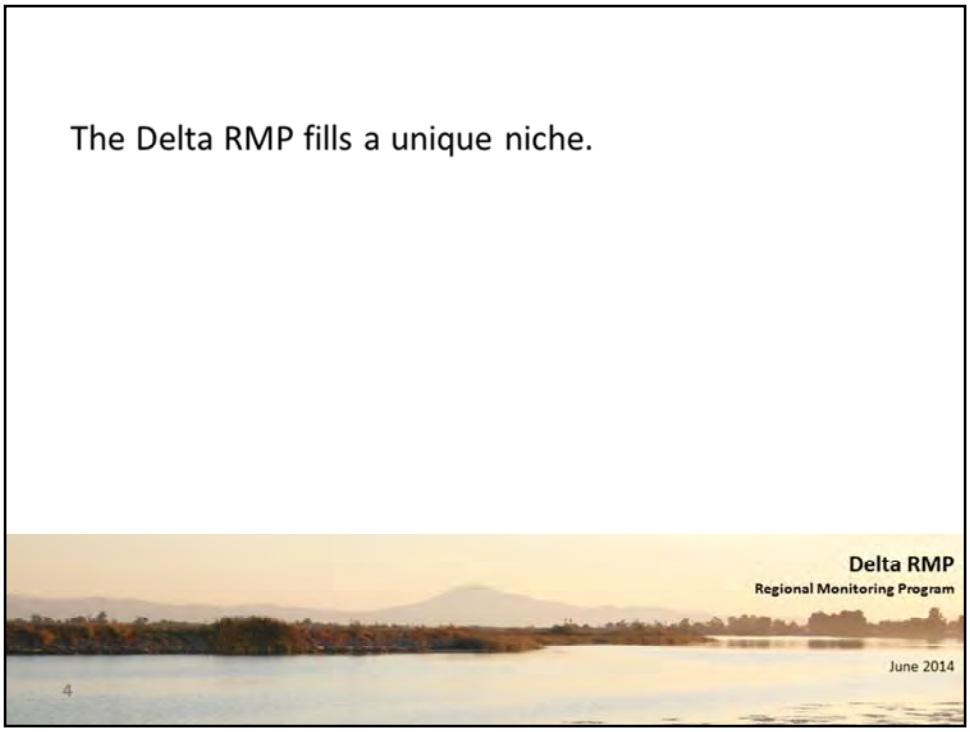

Regulatory – State:
Ken Landau
Central Valley Regional Board
POTWs:
Linda Dorn, Sac Regional
Casey Wichert, City of Brentwood
Erich Delmas, City of Tracy
Coordinated Monitoring:
Gregg Erickson
IEP/CDFW
Resource Agencies:
TBD
Agriculture:
Mike Wackman
SJ County & Delta WQ Coalition
Stormwater Phase II:
Stephanie Reyna-Hiestand
City of Tracy
Stormwater Phase I:
Dave Tamayo
SSQP
Water Supply:
Val Connor
SFCWA
Regulatory – Federal:
Tim Vendlinski
USEPA
Delta RMP Steering Committee



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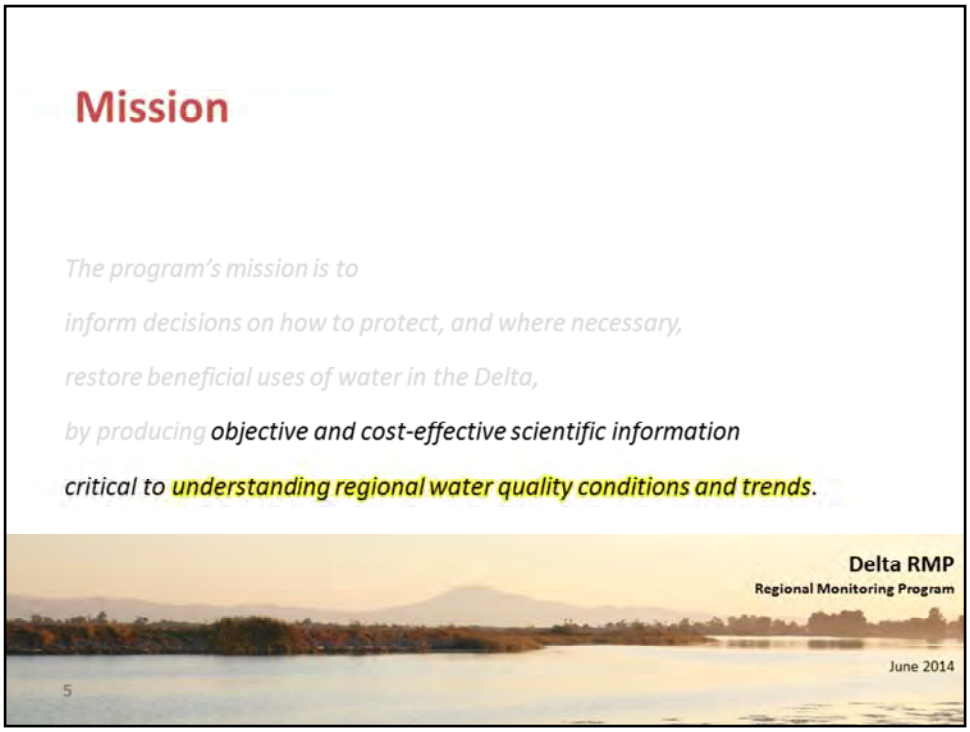

Planning to do three things no one else is doing:

1) Focus on beneficial uses
2) Generate information products for a wide range of audiences
3) Regional view on water quality conditions/stressors

Mission

The program's mission is to

inform decisions on how to protect, and where necessary,

restore beneficial uses of water in the Delta,

by producing objective and cost-effective scientific information

critical to understanding regional water quality conditions and trends.

Delta RMP
Regional Monitoring Program

June 2014

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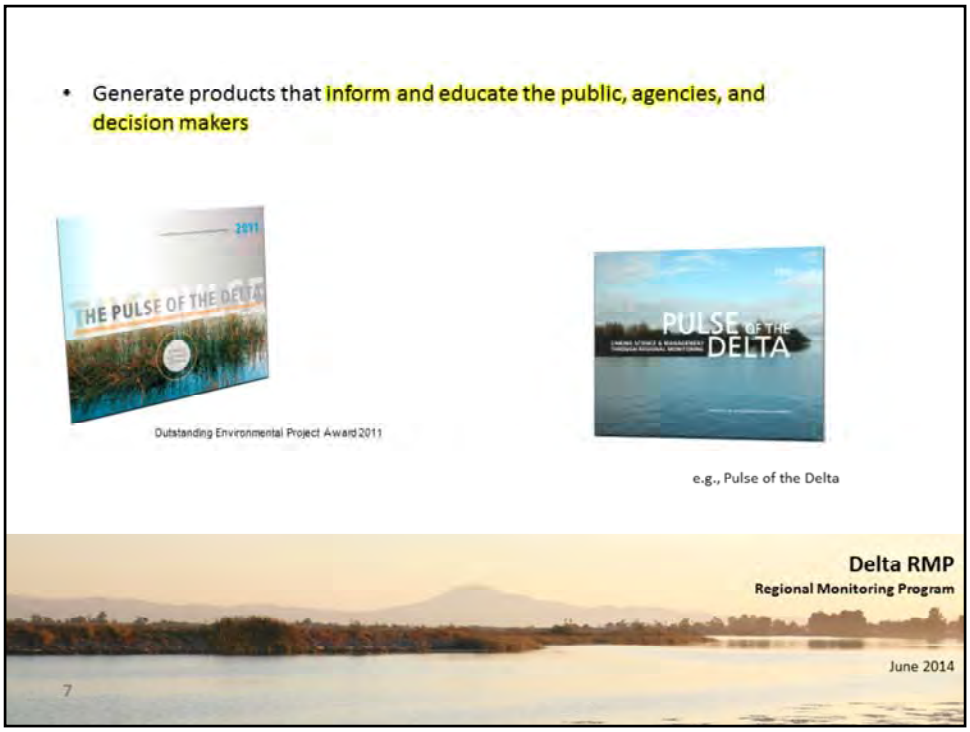


Information products for wide range of audiences.

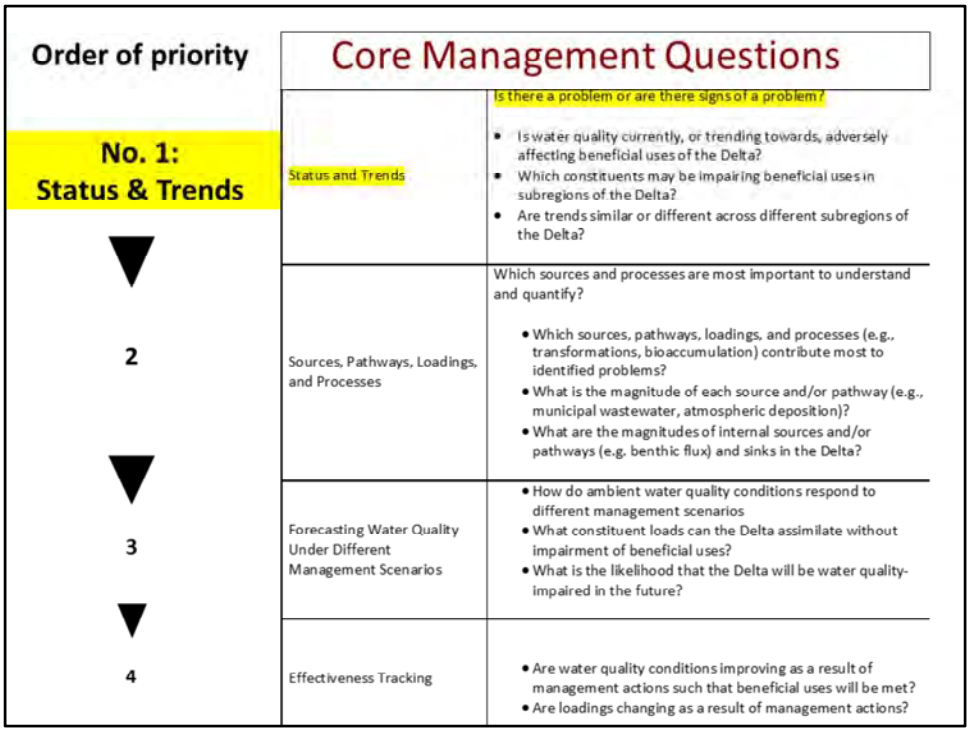
The Pulse represents the type of product the Delta RMP can use to disseminate summarized information to a broader audience.

⇒ Summarizing information so that it can be disseminated to broader audience is important component of RMP work

⇒ A major part of what Delta RMP might contirbute to nutrients monitoring and assessment in Delta might be just that: higher level synthesis and summarization of existing monitoring data.

The Delta RMP and Nutrients Study Plan should build off each other.


Methyl-Mercury in Fish
Ambient Background
Nutrients
Pathogens
Pesticides
Sacramento
Freeport
Vacaville
Fairfield
Walnut Grove
Rio Vista
Isleton
Antioch
Stockton
Lodi
Tracy
0 5 10 15 Miles
N


Order of priority
Core Management Questions
No. 1:
Status & Trends
Status and Trends
Is there a problem or are there signs of a problem?
• Is water quality currently, or trending towards, adversely affecting beneficial uses of the Delta?
• Which constituents may be impairing beneficial uses in subregions of the Delta?
• Are trends similar or different across different subregions of the Delta?
2
Sources, Pathways, Loadings, and Processes
Which sources and processes are most important to understand and quantify?
• Which sources, pathways, loadings, and processes (e.g., transformations, bioaccumulation) contribute most to identified problems?
• What is the magnitude of each source and/or pathway (e.g., municipal wastewater, atmospheric deposition)?
• What are the magnitudes of internal sources and/or pathways (e.g. benthic flux) and sinks in the Delta?
3
Forecasting Water Quality Under Different Management Scenarios
• How do ambient water quality conditions respond to different management scenarios
• What constituent loads can the Delta assimilate without impairment of beneficial uses?
• What is the likelihood that the Delta will be water quality-impaired in the future?
4
Effectiveness Tracking
• Are water quality conditions improving as a result of management actions such that beneficial uses will be met?
• Are loadings changing as a result of management actions?

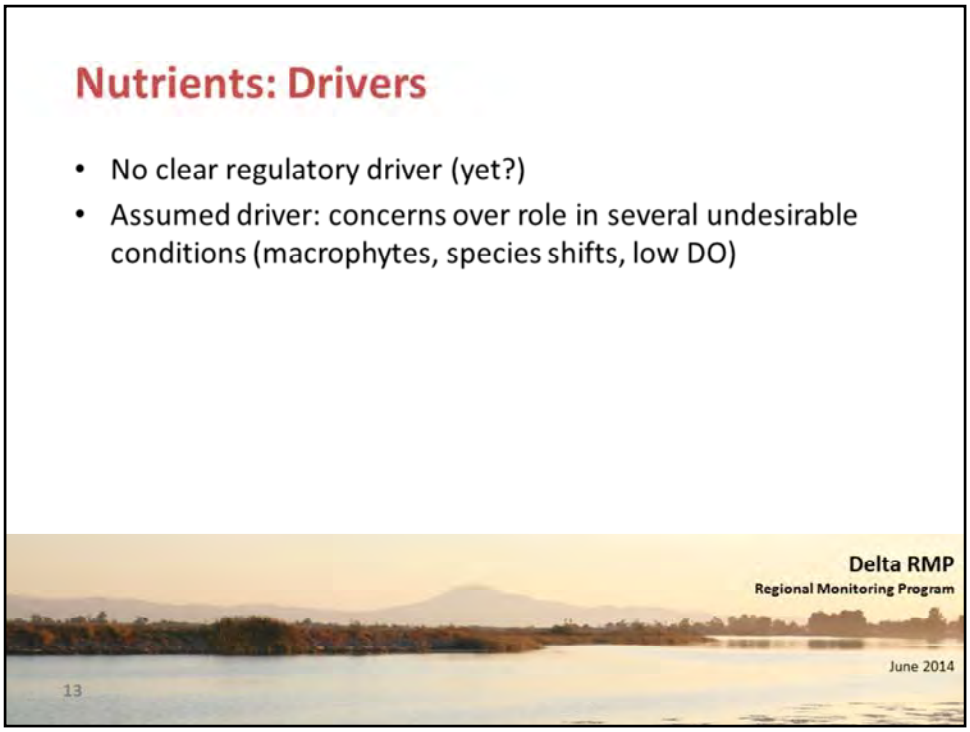
TAC/Subgroup Assignment

- Refine assessment questions
- Describe data products
- ID & review conceptual models
- Assess critical monitoring needs
- Identify coordination efficiencies
- Design & cost monitoring program
- Funding needs & collaboration opportunities

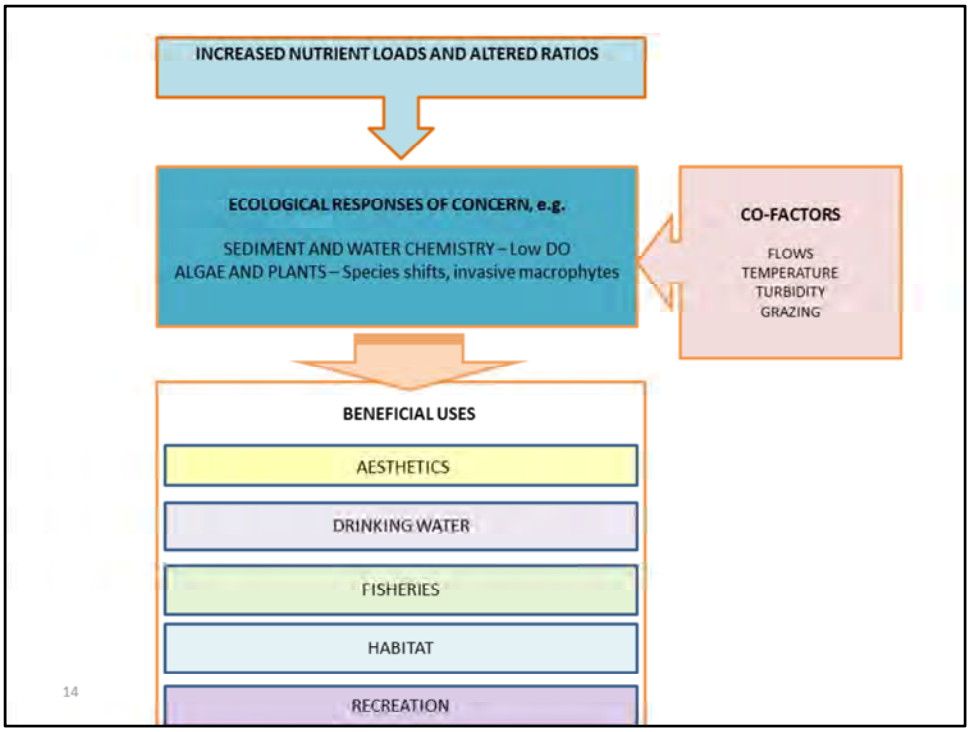
RMP Key Decisions

By end of year:

- What to monitor? How? Where? $$?
- Funding (Year 1)?
- Data management requirements (input, storage, and output of data)?
- Reporting?
- Review?
- Funding (long-term)?
- Participants?



Evolving regulatory guidance; will shape program structure.


INCREASED NUTRIENT LOADS AND ALTERED RATIOS
ECOLOGICAL RESPONSES OF CONCERN, e.g.
SEDIMENT AND WATER CHEMISTRY – Low DO
ALGAE AND PLANTS – Species shifts, invasive macrophytes
CO-FACTORS
FLOWS
TEMPERATURE
TURBIDITY
GRAZING
BENEFICIAL USES
AESTHETICS
DRINKING WATER
FISHERIES
HABITAT
RECREATION
14

Nutrients: Drivers

- No clear regulatory driver (yet?)
- Assumed driver: concerns over role in several undesirable conditions (macrophytes, species shifts, low DO)
- Proposed approach ("no regret steps")
  - Evaluate existing data
  - Identify critical data gaps
  - Augment existing monitoring

Nutrients: Initial Questions

STATUS & TRENDS

- Trends in concentration of nutrients and nutrient associated parameters in Delta subareas?
- What is the current status of the Delta ecosystem as influenced by nutrients?

Nutrients: Initial Questions

Sources, Pathways, Loadings, and Processes

- Which sources, pathways, and transformation processes contribute most to observed levels of nutrients?

Specific Questions	Data Product	Monitoring Activities	Program Development Activities
1. How do nutrient concentrations vary spatially and regionally?	Whisker box plots: x: stations groups by (1) subregion; (2) habitat type; (3) subregion*habitat type	- Synthesis and analysis of historic data	- Establish meaningful subregions and subregion*habitat combinations - Define sampling frame (habitats, subareas)
2. How do nutrient concentrations in Delta subregions vary interannually?	Bar chart: x: year y: annual averages (concentrations)	Synthesis and analysis of historic data - Monitoring TBD	- Power analysis of existing data (IEP EMP discrete/continuous) - Identify gaps
3. How do nutrient in concentrations in Delta subareas vary seasonally and decadally?	Whisker box plots: x: month y: concentrations Data sets: 1975-84,1985-94,1995-2004,2005-14	Synthesis and analysis of historic data - Monitoring TBD	- Power analysis of existing data (IEP EMP discrete/continuous) - Identify gaps
4. What is the interannual variability in Delta subareas in chl-a concentrations?	Bar chart: x: year y: annual averages (concentrations)	Synthesis and analysis of historic data - Monitoring TBD	- Power analysis of existing data (IEP EMP discrete/continuous) - Identify gaps

NUTRIENTS


Delta Nutrient Study Plan
Delta RMP Monitoring Plan
Delta Nutrient Science Plan
Now
Later


Delta RMP
Regional Monitoring Program
May 2014
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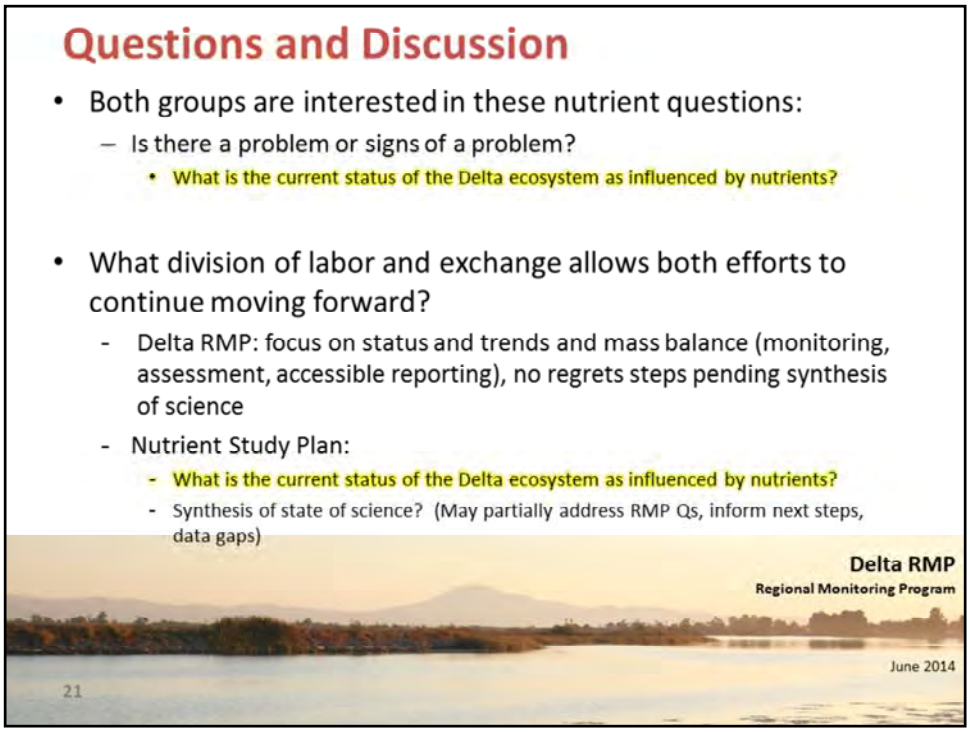
Nutrients: Initial Questions

STATUS & TRENDS

- Trends in concentration of nutrients and nutrient associated parameters in Delta subareas?
- What is the current status of the Delta ecosystem as influenced by nutrients?



How can we best take advantage of the process as it is?

Contact info:
Thomas Jabusch (SFEI-ASC)
(510) 746-7340
thomas@sfei.org

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Goals and Objectives

The primary goal of the Delta RMP is to provide **coordinated Deltawide monitoring, reporting, and assessment of water quality**, while pursuing the following objectives:

- Improve the **efficiency** of water quality data collection and management in the Delta;
- Generate **products** that inform and educate the public, agencies, and decision makers;
- Raise **awareness** of Delta water quality conditions and how they impact beneficial uses;
- Foster **independent science**, objective peer review, and a transparent review process;
- Focus on the **Delta**;
- Focus on the **highest priority water quality information needs**; and
- Contribute to a **holistic understanding** of the Bay-Delta

Delta RMP
Regional Monitoring Program

June 2014

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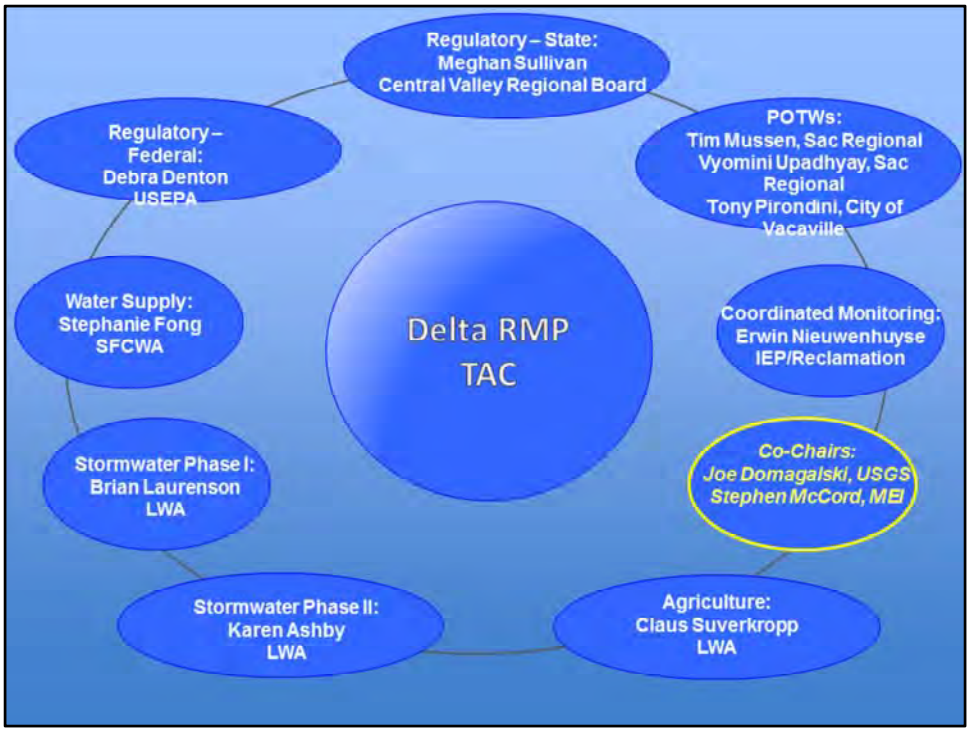
Mention chairs


Regulatory – State:
Meghan Sullivan
Central Valley Regional Board
Regulatory – Federal:
Debra Denton
USEPA
POTWs:
Tim Mussen, Sac Regional
Vyomini Upadhyay, Sac Regional
Tony Pirondini, City of Vacaville
Water Supply:
Stephanie Fong
SFCWA
Delta RMP TAC
Coordinated Monitoring:
Erwin Nieuwenhuyse
IEP/Reclamation
Co-Chairs:
Joe Domagalski, USGS
Stephen McCord, MEI
Stormwater Phase I:
Brian Laurenson
LWA
Stormwater Phase II:
Karen Ashby
LWA
Agriculture:
Claus Suverkropp
LWA

Item 2 – Background
SF Bay NNE
(David Senn's Presentation)


Source: C. Benton

Nutrients in San Francisco Bay: Science to Inform Management

1. Background

2. Activities: Suisun Focus
   - Loads/transformations
   - Suisun Synthesis I and II

3. Program Focus upcoming year
   - Monitoring Program
     - HABs, toxins, optimization (data analysis)
   - Modeling

David Senn
SFEI
Jun 3 2014

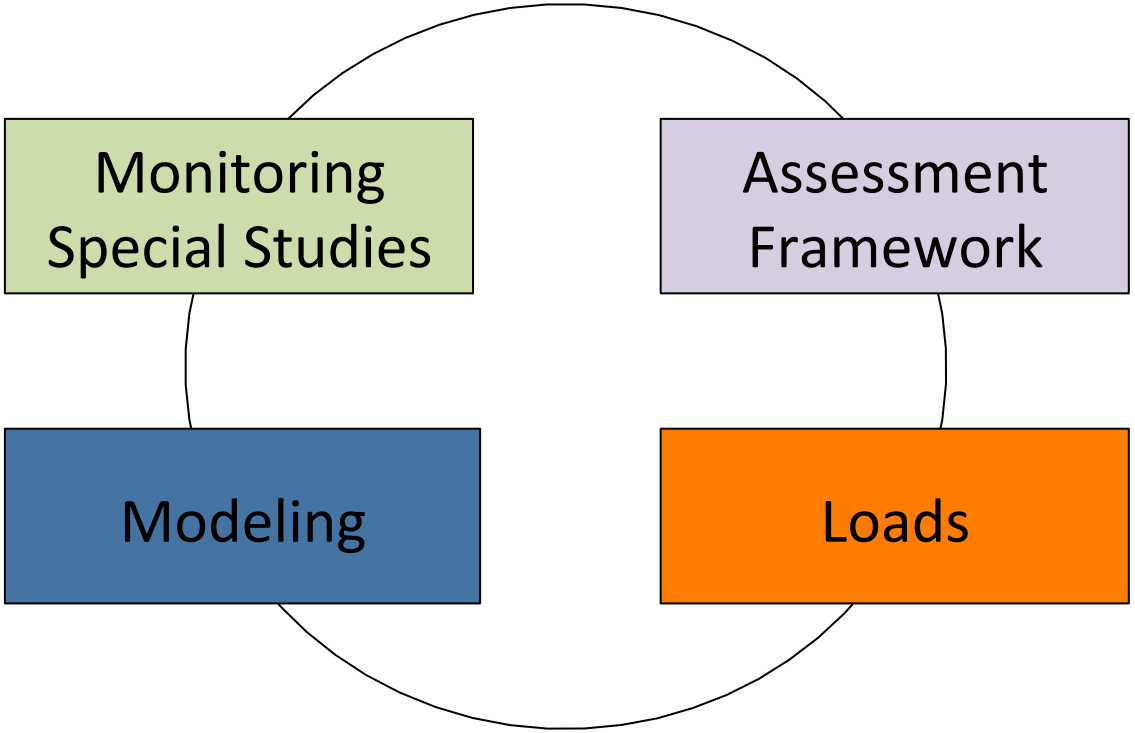
AQUATIC SCIENCE CENTER

November 2012

San Francisco Bay Nutrient Management Strategy

San Francisco Bay Regional Water Quality Control Board

Nutrient Science Program



Key Background Documents (and recommendations)

- Nutrient Strategy

http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/planningtmdls/amendments/estuarineNNE/Nutrient_Strategy%20November%202012.pdf

- Scientific Foundation for a San Francisco Bay Nutrient Strategy (aka, Conceptual Model Report)

SFEI 2014a

Draft. Final in May 2014

http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/planningtmdls/amendments/estuarineNNE/SAG-June-2013/Nutrients_CM_DRAFT_May12013.pdf

- Suisun Bay Ammonium Synthesis

http://www.sfei.org/sites/default/files/SuisunSynthesisI_Final_March2014_0.pdf

- External Nutrient Loads to San Francisco Bay

SFEI 2014b

http://www.sfei.org/sites/default/files/NutrientLoadsFINAL_FINAL_Jan232014_0.pdf

- Approaches to a Nutrient Assessment Framework

SCCWRP 2013

http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/planningtmdls/amendments/estuarineNNE/SAG-June-2013/NNE_Framework_White_Paper.pdf

- Characterizing Nutrient Trends, Loads, and Transformations in Suisun Bay and the Delta.

SFEI 2014d

http://www.sfei.org/sites/default/files/IEP%202014%20ENovick%20FINAL.pdf

- Model Development Plan

http://www.sfei.org/sites/default/files/Nutrient_Modeling_Approach_draftFINAL_Jan212014.pdf

- Numeric nutrient endpoint development for San Francisco Bay – Lit review and data gaps analysis

http://www.sfei.org/sites/default/files/644_SFBayNNE_LitReview%20Final.pdf

- Approaches to a Nutrient Assessment Framework, Draft

http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/planningtmdls/amendments/estuarineNNE/SAG-June-2013/NNE_Framework_White_Paper.pdf

To prioritize among science needs…*consider*

- What management/regulatory decisions need to be made?
- What scientific investigations and monitoring will inform decisions?
- How would different outcomes affect decisions?
- What represents the best combination of investigations and monitoring?

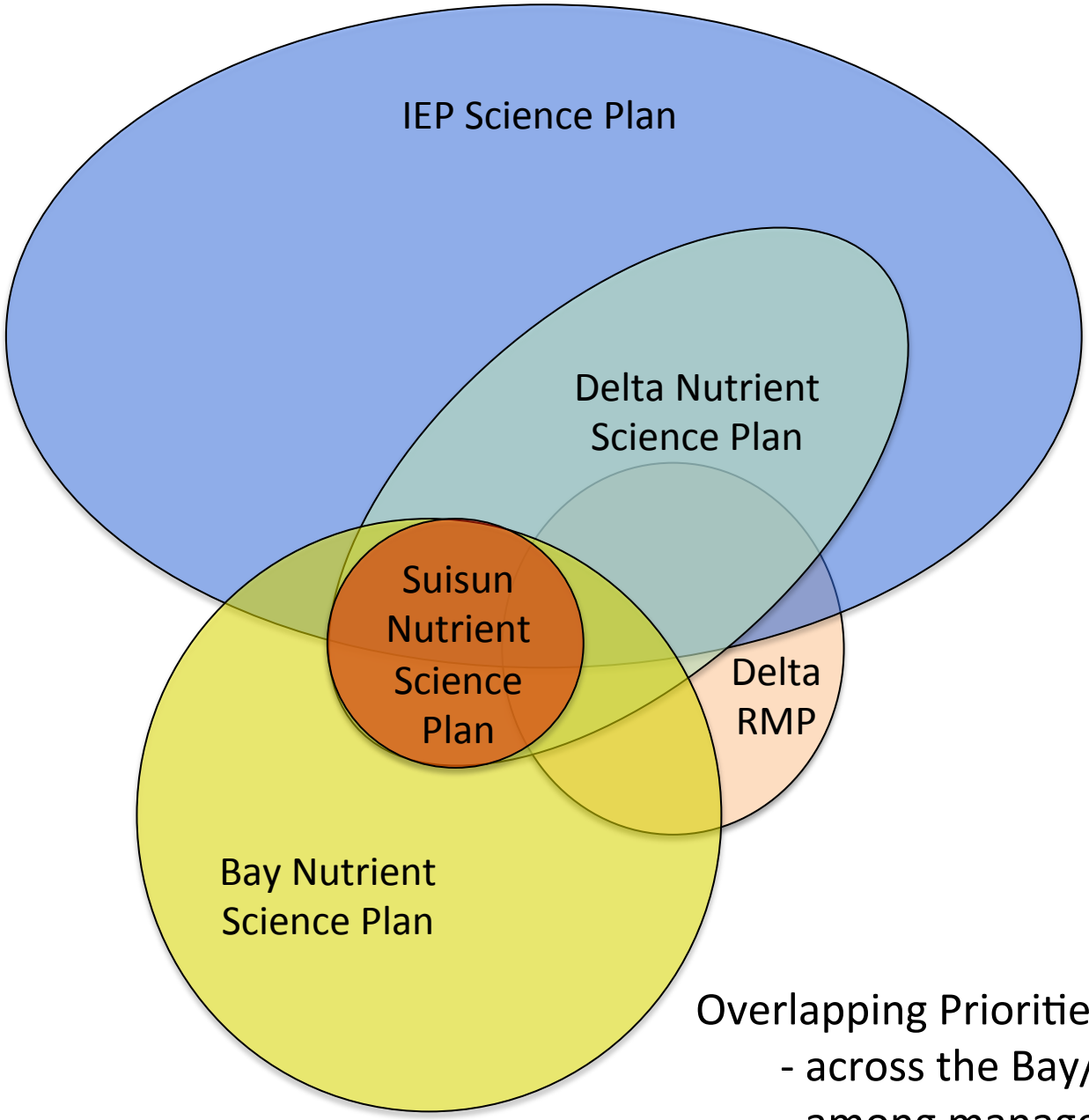
To prioritize among science needs…*consider*

- What management/regulatory decisions need to be made?
  - Convert NH_4^+ to NO_3^- ?
  - Decrease POTW N and P loads by X% and Y%?
  - Decrease agricultural loads and stormwater loads?
  - Regional plans/trading vs. decrease at all sources?

- What scientific investigations and monitoring will inform decisions?

- How would different outcomes affect decisions?

- What represents the best combination of investigations and monitoring?



Overlapping Priorities and Data/Science needs

- across the Bay/Delta
- among management issues/stressors

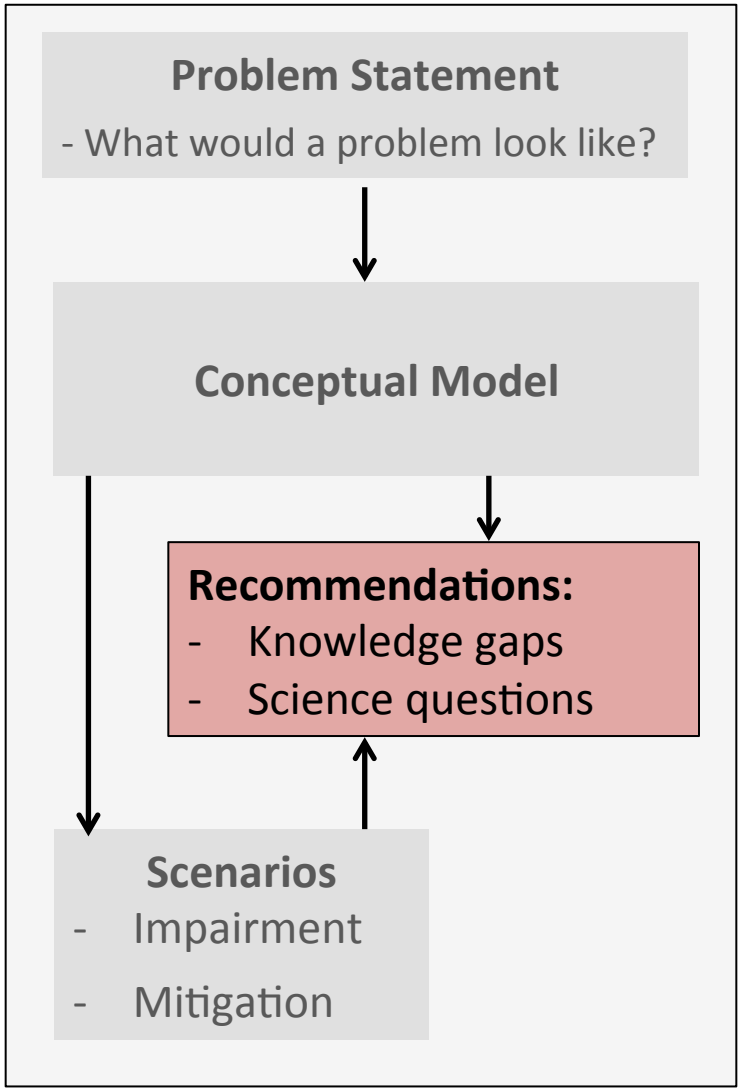
Major Nutrient Questions/Issues in Low Salinity Zone

- Evaluate/quantify nutrients' role in exerting adverse impacts:
  - low productivity, altered phytoplankton community composition, low DO, HABs, macrophytes etc.?
  - Identify 'protective' concentrations/loads
  - Consider current conditions and future scenarios

- What are nutrient loads and fate in Suisun and Delta?

- What nutrient management actions will protect ecosystem health?

'Scientific Foundation for a San Francisco Bay Nutrient Strategy'

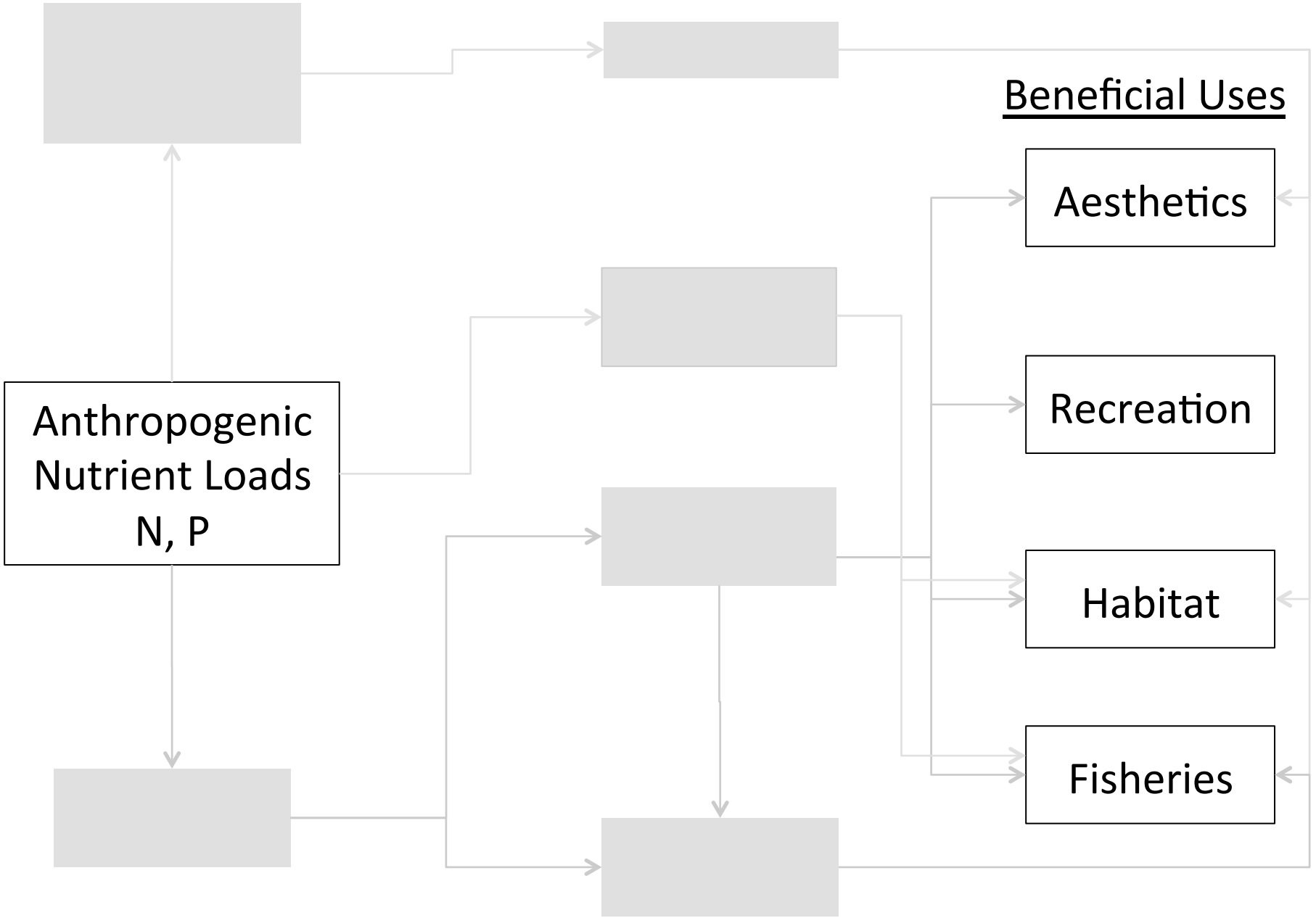


Technical Team

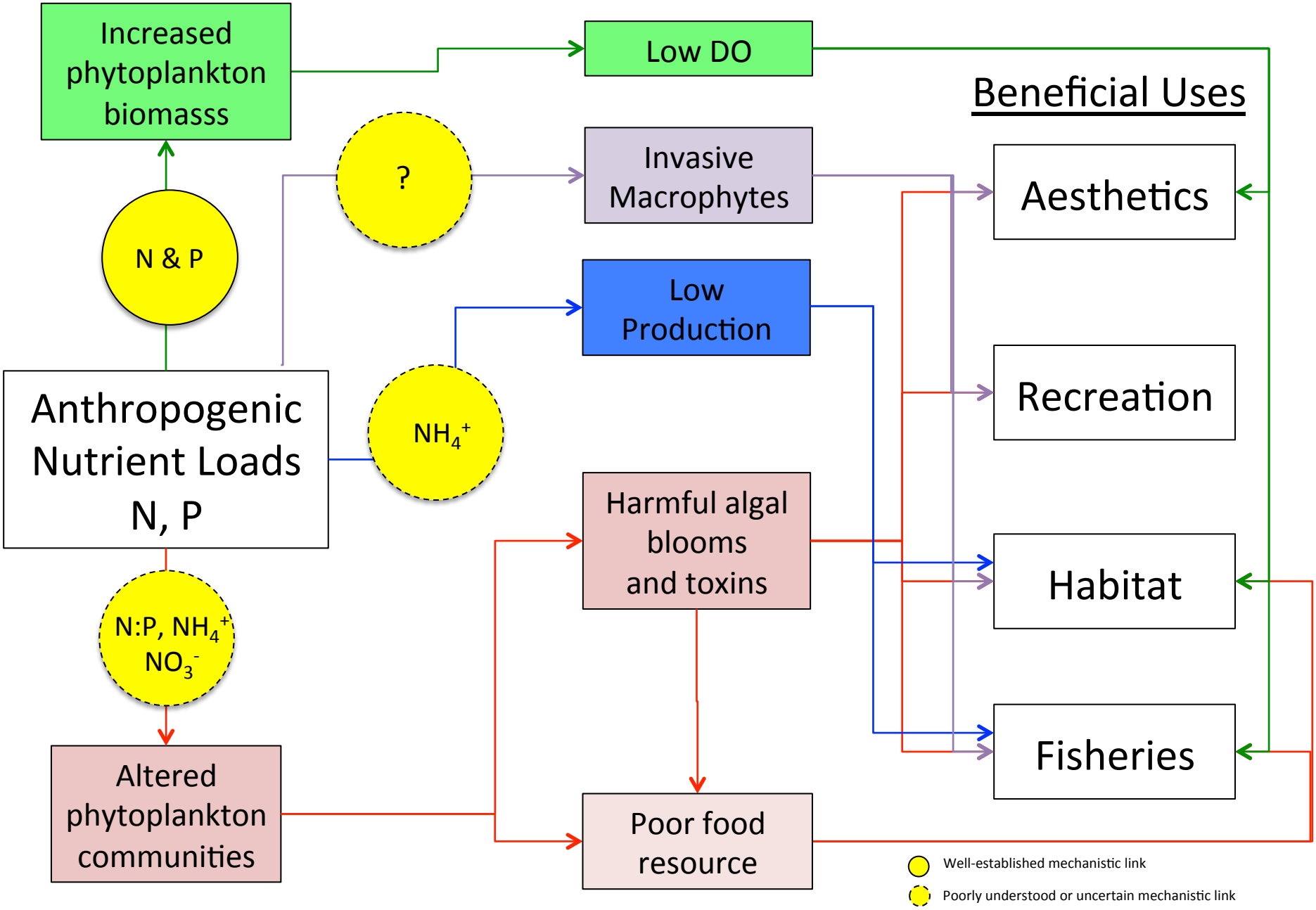
Jim Cloern	USGS
Mike Connor	EBDA
Dick Dugdale	SFSU-RTC
Tim Hollibaugh	U-Georgia
Lisa Lucas	USGS
Wim Kimmerer	SFSU-RTC
Raphe Kudela	UCSantaCruz
Anke Mueller-Solger	IEP
Mark Stacey	UCBerkeley
Martha Sutula	SCCWRP

SFEI 2014b

Potential Pathways to Adverse Impacts



Potential Pathways to Adverse Impacts



Suisun Bay: evaluating potential impacts of nutrients

Synthesis I:

- NH4 and low phyto biomass
- NH4 and copepods
- Ambient NH4 – sources, fate

Synthesis II

- N:P, NH4:NO3 on phytoplankton community composition

Nutrient Science Plan:
- Priority management questions
- Priority science questions

Implement

Technical Workshop

External Science Review

Suisun Synthesis I

1. Synthesize the scientific literature on N utilization by marine and estuarine phytoplankton *(M Berg, AMS)*

2. NH4's role in low phytoplankton biomass: evaluate/synthesize recent studies

   (D Senn and T Jabusch, SFEI)

3. Synthesize scientific literature on copepod ecology and changes in community composition and abundance in Suisun

   (W Kimmerer, SFSU-RTC)

4. NH4 loads and concentrations: seasonal and long-term trends, and NH4 fate *(E Novick and D Senn, SFEI)*

5. Next steps, recommendations *(D Senn and E Novick, SFEI)*

Suisun Synthesis II

1. Assessing nutrient role in shaping phytoplankton community composition: focus SFB *(Berg, Kudela, Senn, others)*

2. Long-term trends in phytoplankton community composition: Suisun Bay and Delta

   (Malkassian, Kudela, Cloern, Senn)

3. N and P loads and concentrations: seasonal and long-term trends, fate *(SFEI staff)*

4. Next steps, recommendations

Major Nutrient Questions/Issues in Low Salinity Zone

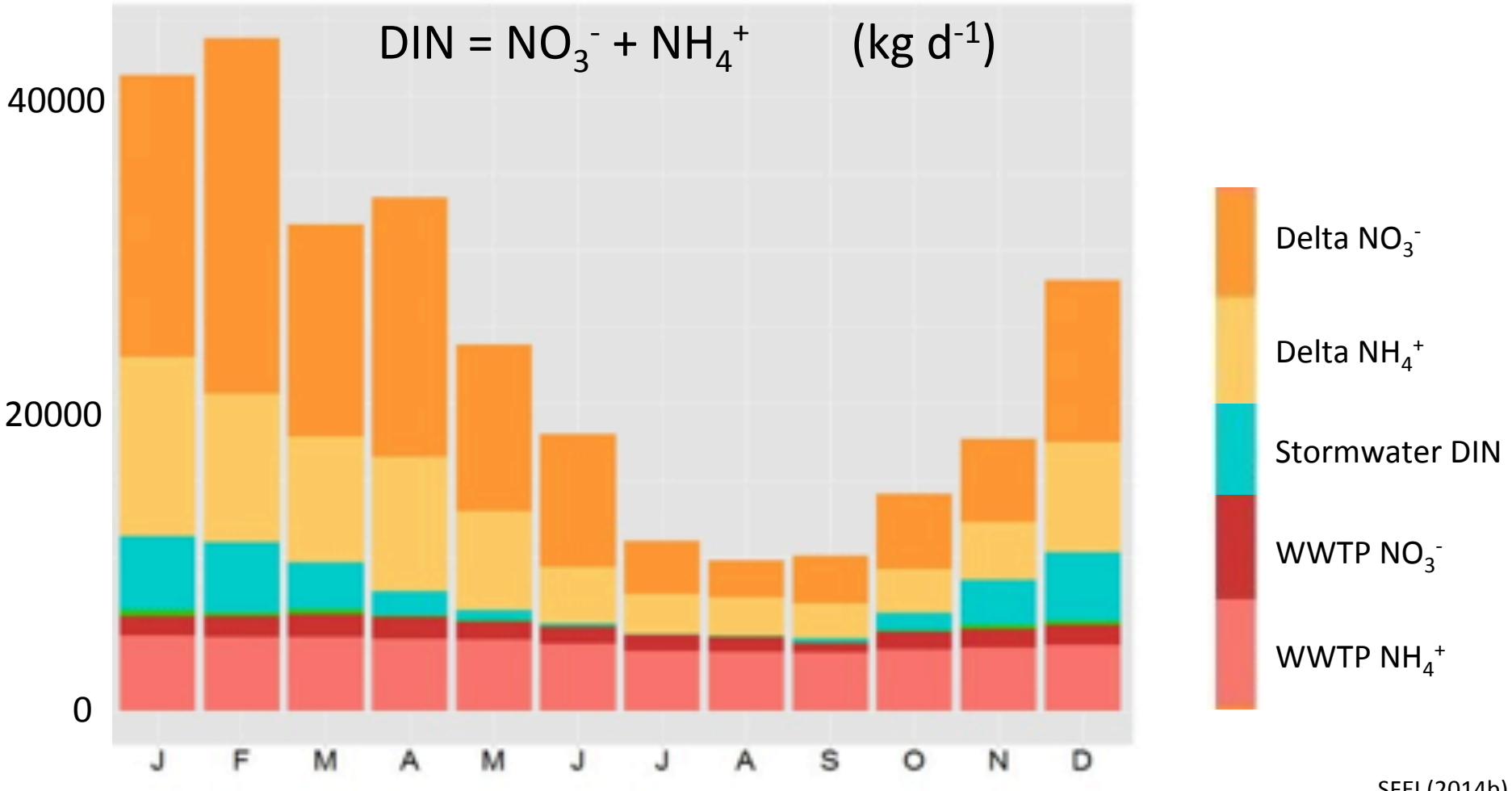
- Evaluate/quantify nutrients' role in exerting adverse impacts:
  - low productivity, altered phytoplankton community composition, low DO, HABs, macrophytes etc.?
  - Identify 'protective' concentrations/loads
  - Consider current conditions and future scenarios

- What are nutrient loads and fate in Suisun and Delta?

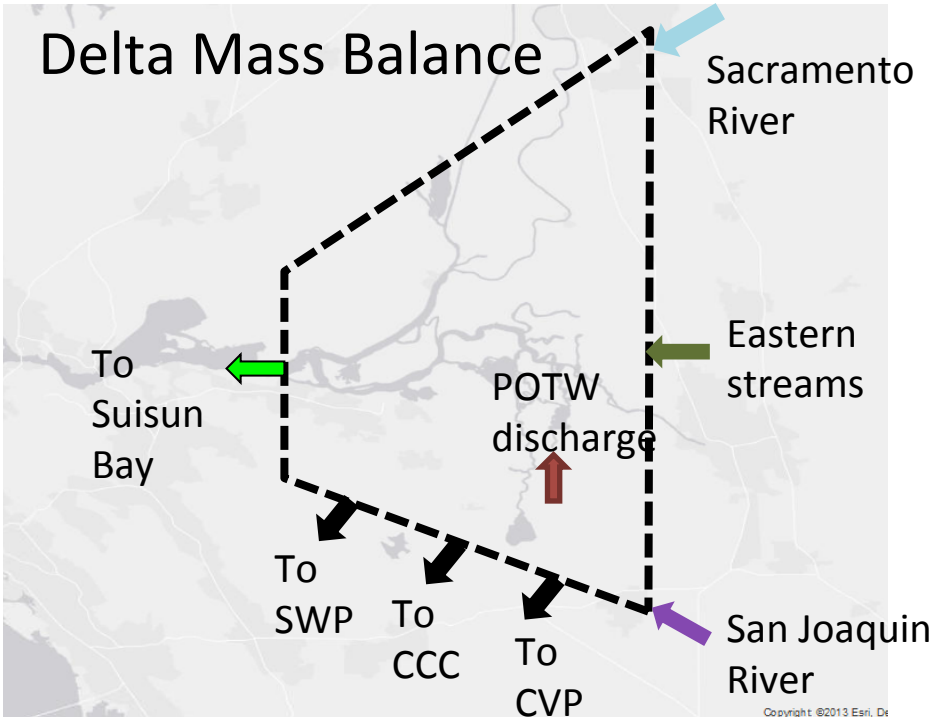
- What nutrient management actions will protect ecosystem health?

Sources of Nitrogen: Suisun Bay

- Strong seasonality in magnitude and relative importance of sources/forms
- Other SFB subembayments' loads are WWTP dominated



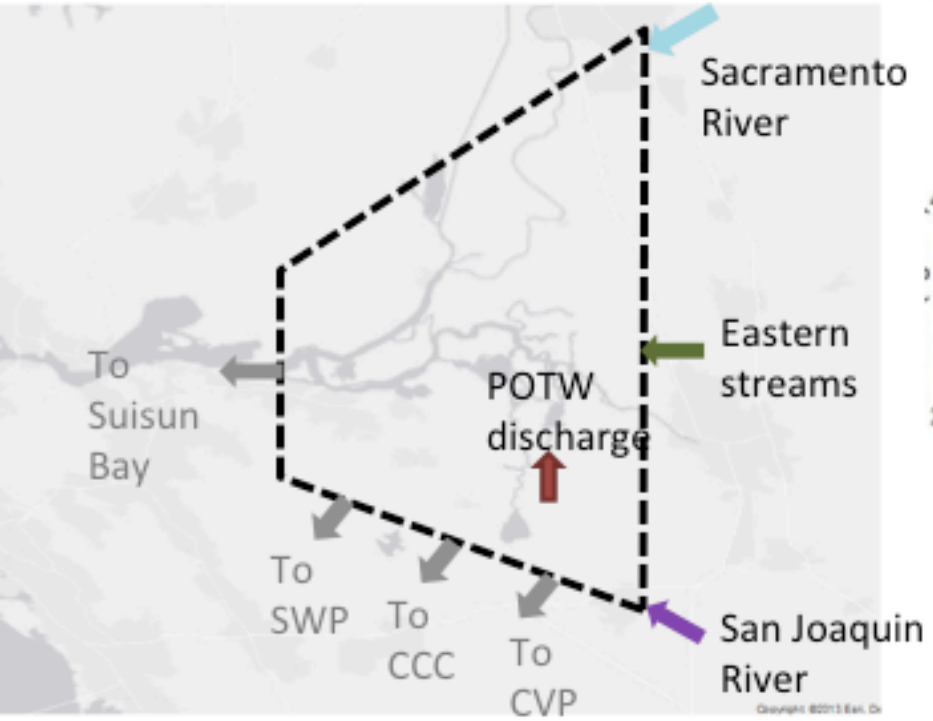
SFEI (2014b)

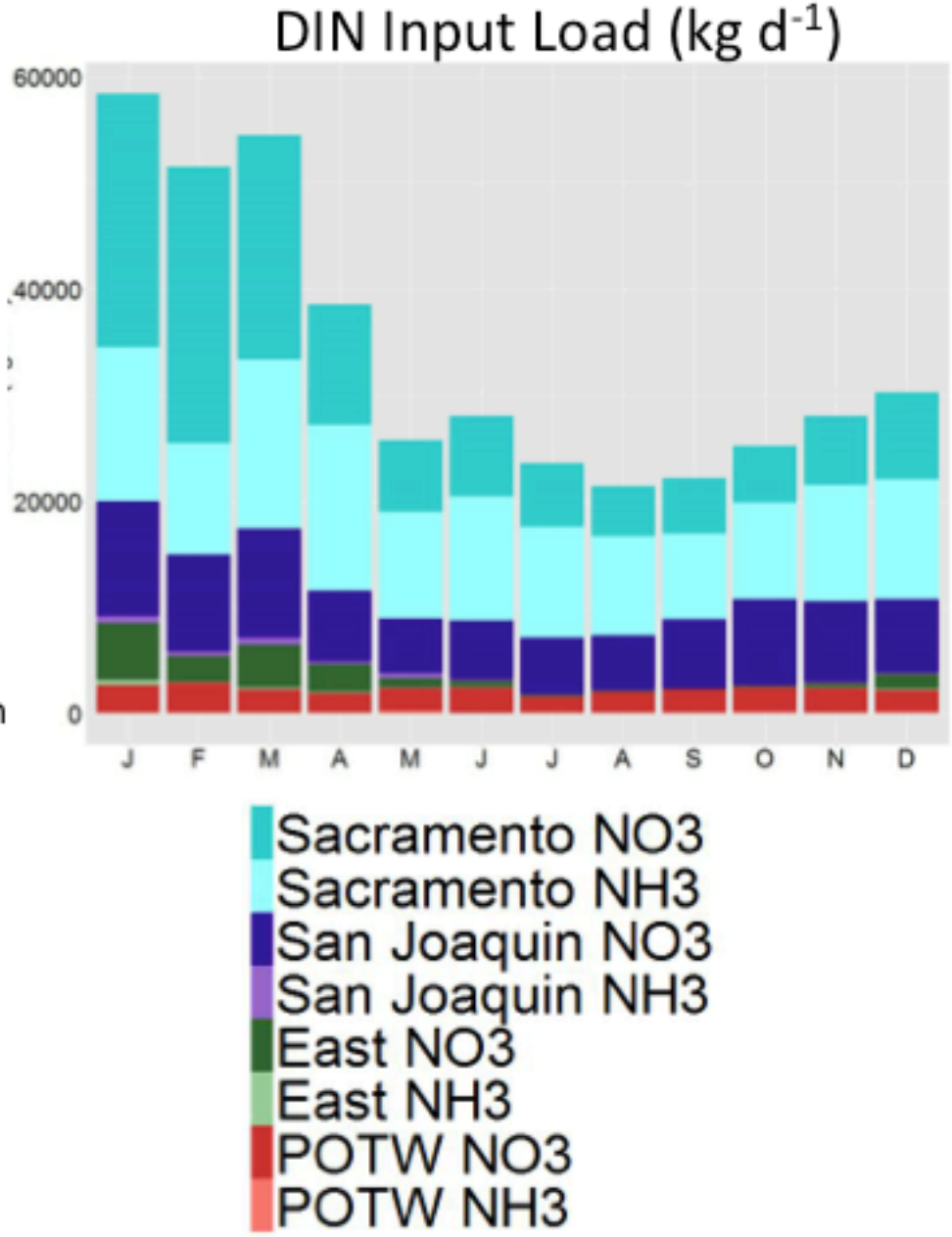


- Flow (DAYFLOW, 1975-present)
- Water quality data (DWR-EMP, 1975-present)

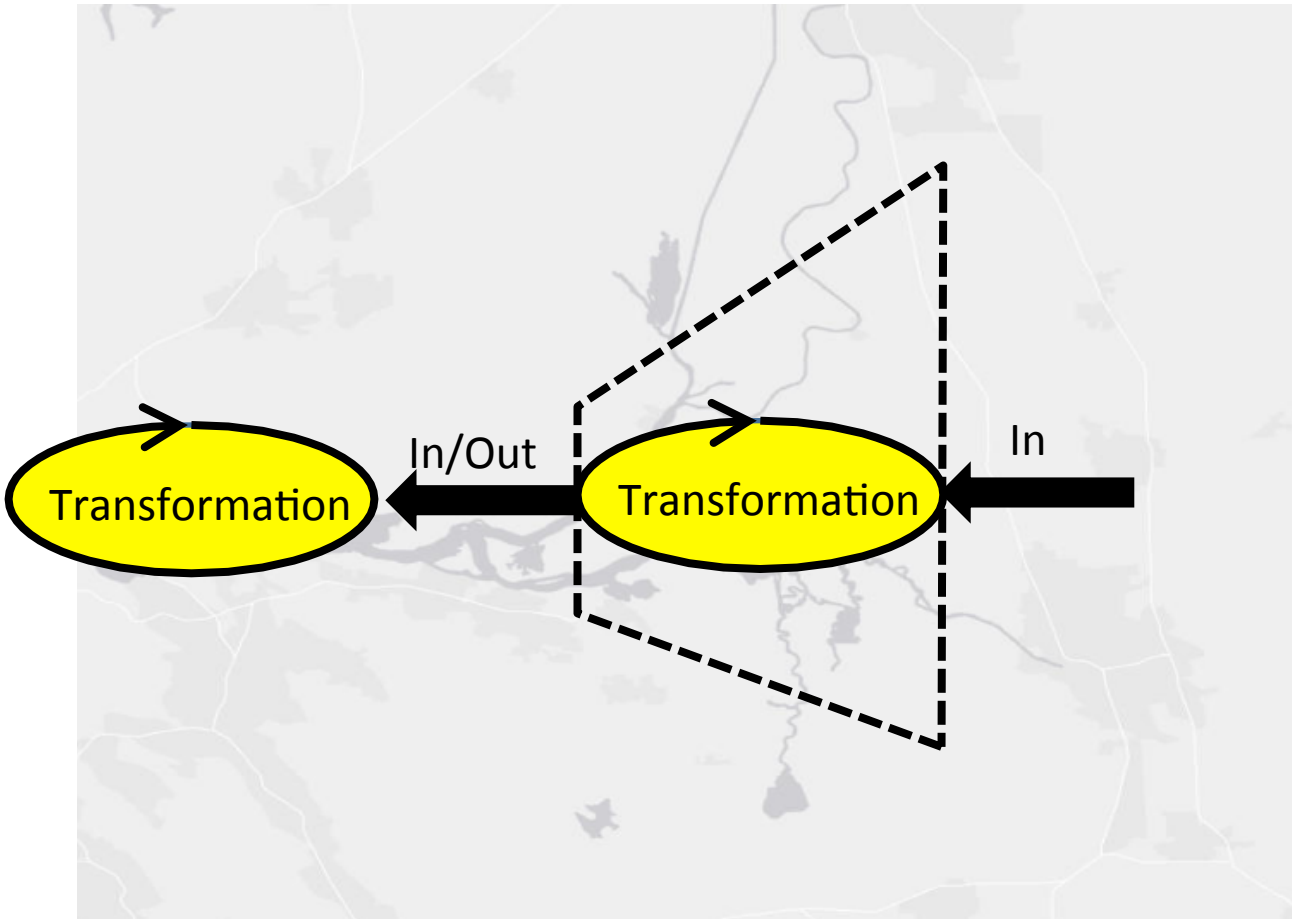
SFEI 2014d

Input Loads


Sacramento River
Eastern streams
POTW discharge
To Suisun Bay
To SWP
To CCC
To CVP
San Joaquin River


DIN Input Load (kg d-1)
60000
40000
20000
0
J
F
M
A
M
J
J
A
S
O
N
D
Sacramento NO3
Sacramento NH3
San Joaquin NO3
San Joaquin NH3
East NO3
East NH3
POTW NO3
POTW NH3

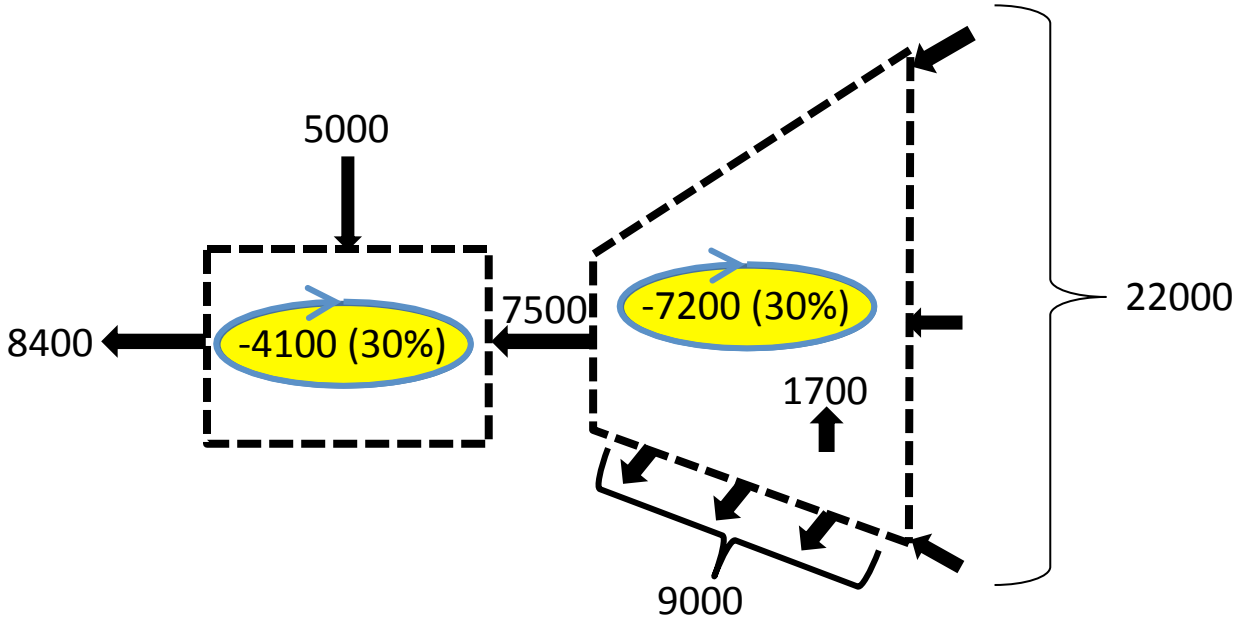
Fate of nutrients in the Delta and Suisun?



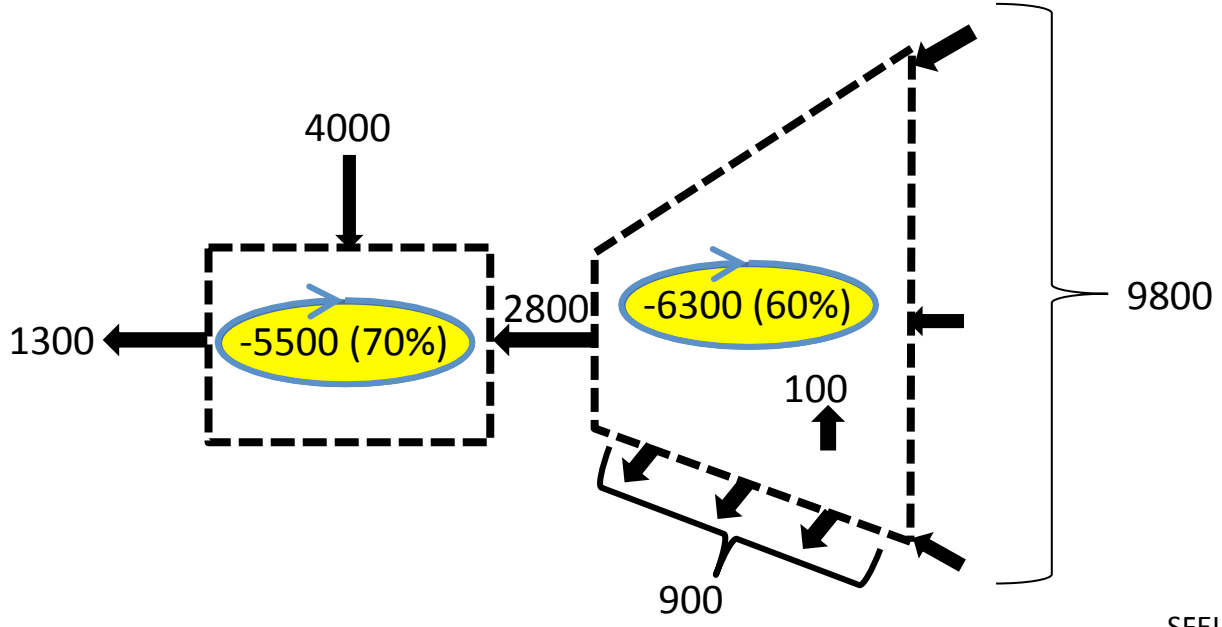
SFEI 2014d

Delta-Suisun Mass Balance – June-October

DIN (kg d^{-1})



NH_4^+ (kg d^{-1})



SFEI 2014d

Upcoming Priorities (Jul 2015 – Jun 2016)

- Monitoring program development
  - HABs, toxins
  - Phytoplankton composition
  - Moored sensors
- Water Quality Modeling
- Science Plan Development

Item 2 – Background
State Board NNE
(Martha Sutula's Presentation)

Science Supporting Nutrient Management in California's Aquatic Habitats

June 3, 2014

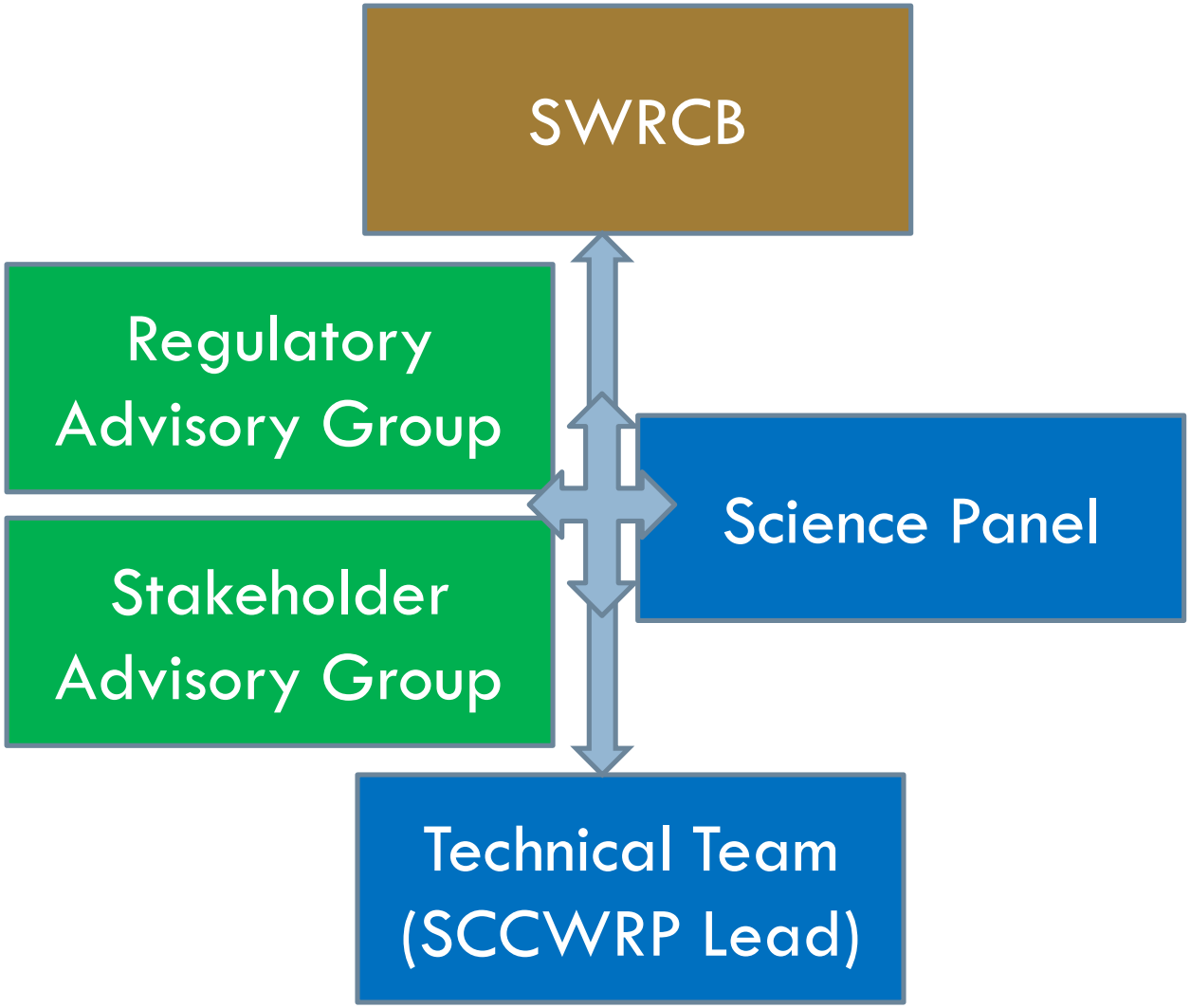
Delta Nutrients Subcommittee Meeting

Martha Sutula
Principal Scientist
Southern California Coastal Water Research Project

SWRCB Is Developing Nutrient Objectives, Phased By Waterbody Type

- Considering narrative objective, with numeric guidance
- Phase I: 2014-2017: Establish conceptual approach applicable to all waterbodies and numeric guidance for wadeable streams
- Phase II: 2014-2018: Numeric guidance for lakes
- Phase III: 2014-2020: Numeric guidance for estuaries and non-wadeable rivers
- Supporting SF Bay and Delta nutrient science

Statewide Nutrient Objectives Program: Organization



SWRCB Staff Favor Ecological Response Approach to Nutrient Objectives

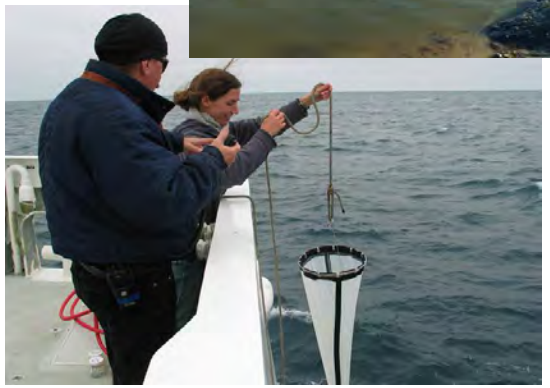
- Approach consists of two major components
  - Response indicators with numeric endpoints for waterbody assessment
  - Models to link response indicator numeric endpoints to numeric nutrient targets
- Coined as "nutrient numeric endpoint (NNE) approach"

Algae & Aquatic Plants

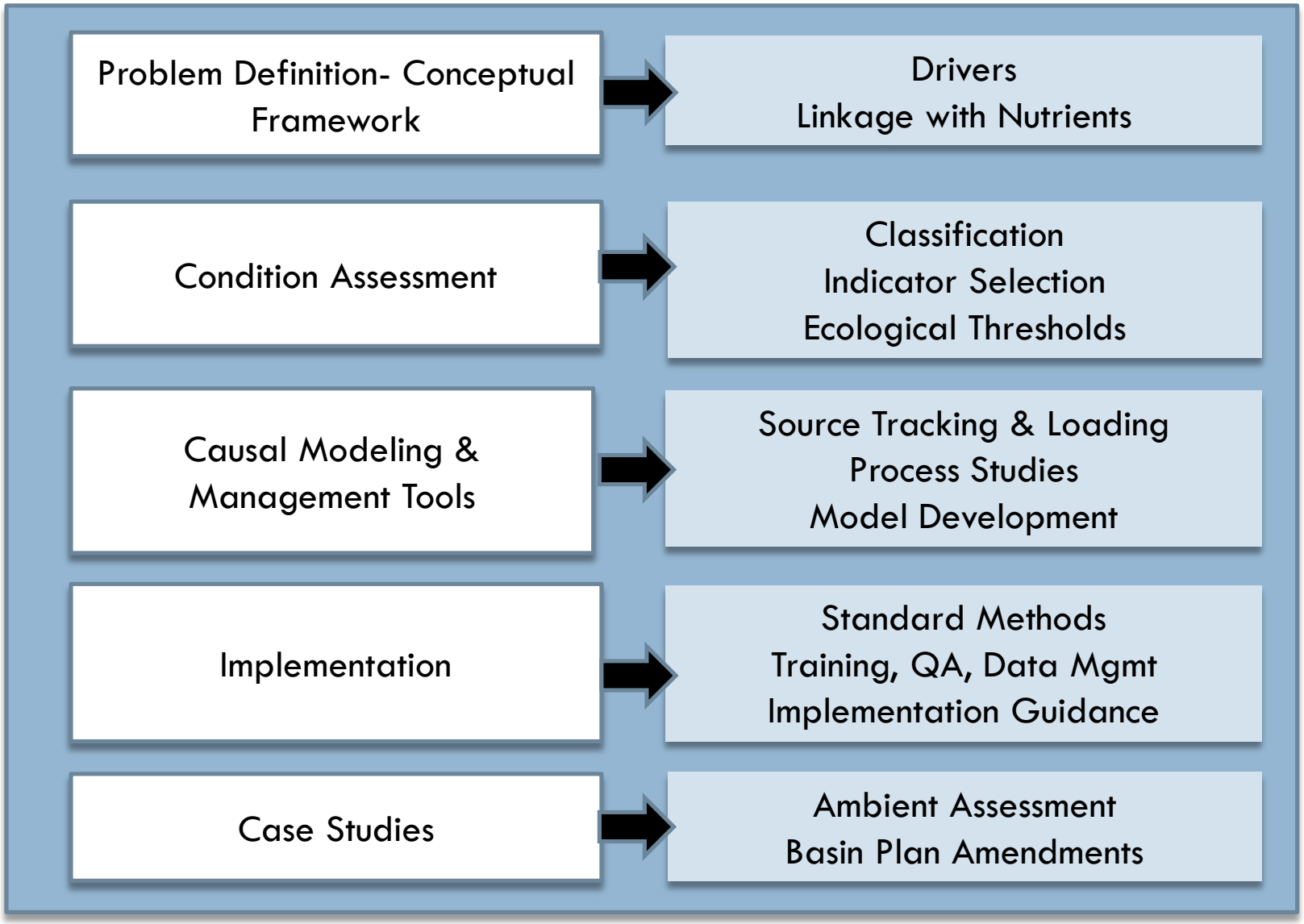
Dissolved Oxygen, pH

Conducting and Synthesizing Science To Support Nutrient Objective Research across Waterbody Types

- Wadeable streams
- Lakes
- Estuaries
- Non-wadeable rivers
  - Haven't yet addressed;
  - Great partnership opportunity with Delta



Science to Support NNE Approach Has Five Fundamental Elements

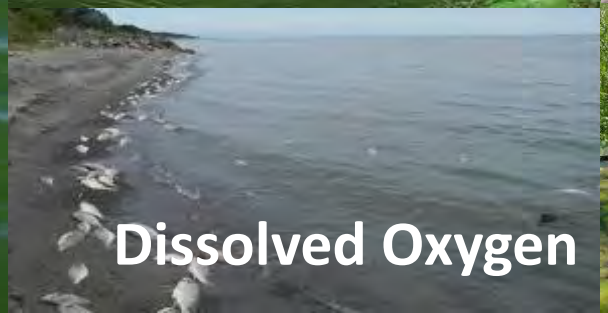


Immediate Opportunities for Science Partnerships On Condition Assessment

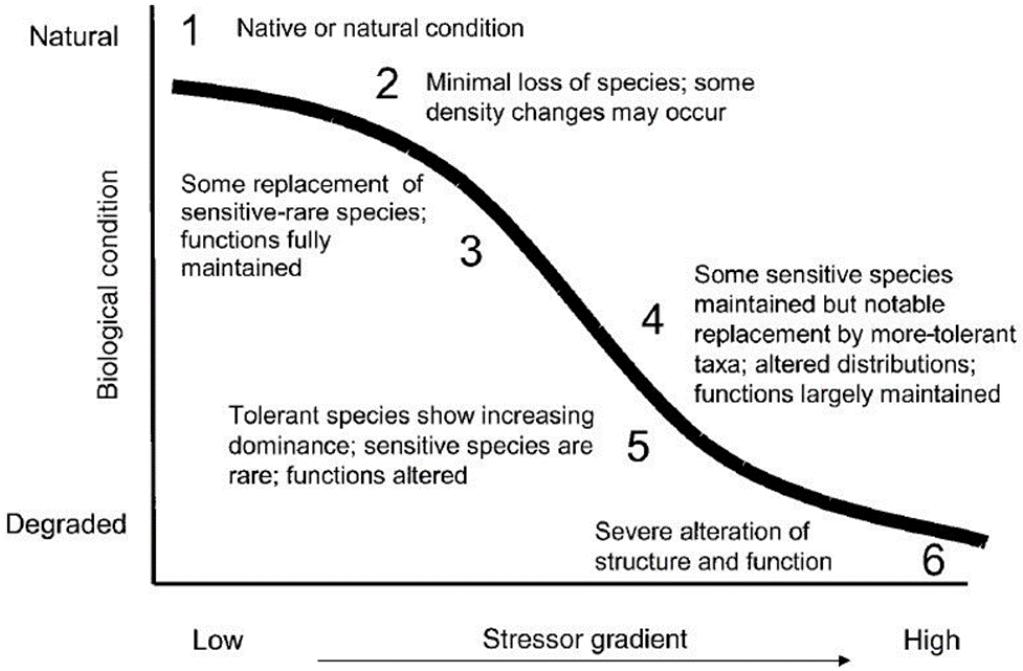
- What are the appropriate response indicators?
  - Conceptual models of linkages with anthropogenic nutrients and other environmental variables
- Are their identifiable ecological thresholds in the relationship between stressors (response indicators) and beneficial uses (aquatic life, etc.)?

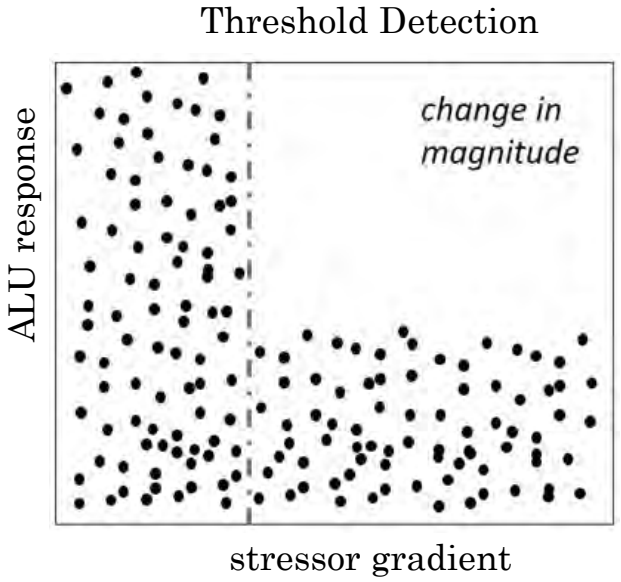
Indicators By Waterbody Type Overlap with Delta "Symptoms of Impairment"

Estuarine	Lakes	Wadeable Streams
Dissolved oxygen	Dissolved oxygen	Dissolved oxygen (and pH)
Phytoplankton Biomass and Productivity	Phytoplankton Biomass	Benthic algal biomass
HAB cell counts & toxin conc.	Cyanobacteria cell counts & toxin conc.	Cyanobacteria cell counts & toxin conc.
Macrobenthos /Sediment OM		Benthic ash-free dry mass
Macroalgal Biomass & Cover		Algal & Macrophyte % Cover



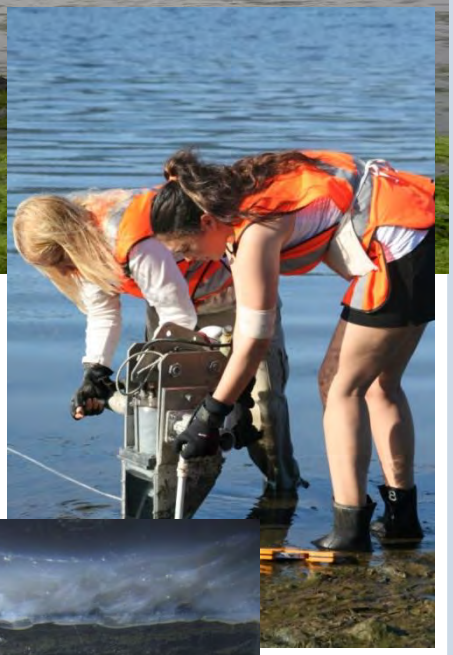
Detecting Ecological Thresholds Along A Biological Condition Gradient

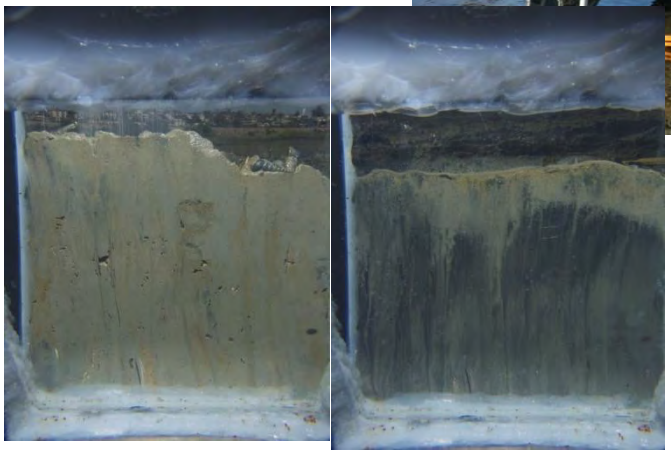




Studies and Synthesis Supporting Decisions on Response Indicator Endpoints

- Field experiments studies
- Modeling studies
- Fields surveys to relate stress-response
- Studies to characterize natural background at “reference sites”
- Expert best professional judgment to address data gaps





Thresholds Synthesized into "Assessment Frameworks"

Macroalgal Assessment Framework For Estuarine Tidal Flats and Shallow Subtidal HAbitat

Biomass (g dw m^{-2})	%Percent Cover				
	< 10 %	10 - 25 %	25 - 40 %	40 - 70 %	> 70 %
>175	Moderate	Low	Low	Very Low	Very Low
100 - 175	Moderate	Moderate	Low	Very low	Very Low
70-100	Moderate	Moderate	Low	Low	Low
50 - 70	High	High	Moderate**	Moderate**	Low
15 - 50	Very High	High	High	Moderate	Moderate
< 15	Very High	Very High	High	High	Moderate

** downgrade if moderate for 2 consecutive sampling periods

from Sutula (2013); Draft Framework for Assessment of Macroalgae in California Estuaries

Great Time to Partner On Science

- First Statewide Stakeholder Group meeting June 13, 2014
  - Statewide website to link to technical products
- Forming a Science Panel to provide ongoing technical review
  - Wadeable streams
  - Estuaries
  - Opportunity to include SF Bay-Delta in the review
- Science plan to support numeric guidance
  - Wadeable streams- draft expected August 2014
  - "Other estuaries" – Updated draft September 2014
- Opportunity to strengthen partnership on science

Martha Sutula 714-755-3222, Marthas@sccwrp.org

SWRCB Staff Proposal for Selection of Nutrient Objectives Science Panel (SP) Members: Process, Attributes and Proposed Candidates
May 23, 2014 Draft

Context: The State Water Resources Control Board (SWRCB) is developing nutrient objectives (SWRCB 2014). A group of four scientific experts will be empanelled to provide ongoing technical review for the products of SWRCB's nutrient objective development program. This includes technical work for wadeable streams and estuaries, including San Francisco Bay. The purpose of this document is to provide an overview of the process, suggested attributes of the Science Panel (SP), and propose candidates for the positions.

The proposed process, attributes sought, and a subset of the candidate members have previously been vetted for San Francisco Bay and other estuaries in the State by the Regulatory Advisory Group (formerly known as STRTAG), the San Francisco Bay and Coastal Stakeholder Advisory Groups (SAGs).

The scope of the Science Panel is now being expanded to include technical work supporting nutrient objective development in freshwater habitats (streams, rivers and lakes). The existing Stakeholder Advisory Group will be likewise expanded. For this reason, the SWRCB staff need to: 1) expand the expertise on the Panel to provide coverage for freshwater habitats, and 2) vet the process, suggested attributes and choose candidates for the positions.

Process:

- Technical Team lead (SCCWRP) identifies candidates, based on desired attributes of SP panel members
- Members of the Regulatory Advisory Group (RAG) and SAG:
    - Review nominated candidates
    - Have right to reject individual candidates
    - Rank the candidates in the preferred order
- Technical Team lead (SCCWRP) summarizes stakeholder input and provides to SWRCB staff
- SWRCB staff makes final decision

Desired Attributes:

Four Science Panel members will be empaneled. The Science Panel members should not have a conflict of interest (e.g. by having conducted significant work in California freshwater and estuarine habitats that would likely be subjected to technical review). These four members will

be national or internationally-recognized experts in science and management of eutrophication and possess technical expertise in one of the following areas:

- Nutrient and organic biogeochemistry and/or ecology with experience in management of eutrophication in estuaries;
- Nutrient and organic biogeochemistry and/or ecology with experience in management of eutrophication in freshwater habitats;
- Development of statistical and computational models describing relationship between nutrients, environmental variables and ecological response;
- Creation of nutrient-related water quality criteria and/or numeric targets and implementation of management actions to address eutrophication.

Candidates:

Area	Name	Links
Aquatic ecology, nutrient bio-geochemistry and management of eutrophication in ESTUARIES	Walter Boynton, Professor University of Maryland	http://www.umces.edu/cbl/people/wboynton http://www.gonzo.cbl.umces.edu/
	Ivan Valiela, Professor, Boston University	http://people.bu.edu/valiela/index.html
	Robert Twilley, Professor, Louisiana State University	http://www.sce.lsu.edu/index.php/people1/faculty/robert-r-twilley/
	Robert Diaz, Professor, Virginia Institute of Marine Science	http://www.vims.edu/people/diaz_rj/
Aquatic ecology, nutrient bio-geochemistry and management of eutrophication in FRESHWATER HABITATS	Hans Pearl, Professor, University of North Carolina	http://marine.unc.edu/people/faculty-2/hans-paerl/
	Judith Meyer, Professor, University of Georgia	http://www.ecology.uga.edu/facultyMember.php?Meyer-45/
	Robert (Jan) Stevenson, Professor, Michigan State University	http://scholars.opb.msu.edu/expert.asp?n=Robert+Jan+Stevenson&u_id=2387&o_id=65
	Stephen Carpenter, Professor, University of Wisconsin	http://limnology.wisc.edu/personnel/carpenter/
Water quality computer simulation modeling, statistical stress-response models	Ken Reckhow, Professor Emeritus, Duke University	http://fds.duke.edu/db/Nicholas/esp/faculty/reckhow
	Dominic DiToro, Professor, University of Delaware	http://www.ce.udel.edu/faculty/ditoro/
	Victor Bierman, LimnoTech Inc.	http://www.limno.com/ourpeople.html#ad
	Don Scavia, Professor, University of Michigan	http://graham.umich.edu/scavia/

Development of Nutrient Water Quality Objectives and Implementation of Nutrient Management Measures	Richard Batiuk, Assistant Director, Chesapeake Bay Program	Institution: http://www.epa.gov/chesapeakebaytmdl/ Short bio: http://www.ci.uri.edu/Projects/mon_ind/Presentations/BatiukShortbio.htm
	Holly Greening, Executive Director, Tampa Bay Estuary Program	Institution http://www.tbep.org/
	Paul Stacey, Connecticut Department of Environmental Protection	See biosketch (appendix 1)
	Ephraim King, Former Director of EPA OST	See biosketch (appendix 1)

Paul Stacey, Connecticut Department of Environmental Protection

Paul E. Stacey is Supervising Environmental Analyst with the Connecticut Department of Environmental Protection's Bureau of Water Management (since 1985). He oversees agency participation in the Long Island Sound Study (LISS) and Long Island Sound (LIS) management programs and the state's nonpoint Source Program. Previously he spent eight years at the Academy of Natural Sciences Applied Ecology Program. Mr. Stacey recei ved a B.A. in Psychology from the College of the Holy Cross, Worcester, MA (1972), a B.S. in Wildlife and Fisheries from Utah State University (1974), and an M.S. in Fisheries Biology from Colorado State University (1977).

As a principal state water quality analyst and manager focusing on cultural eutrophication, Mr. Stacey is well versed in the study of reactive nitrogen sources; air, watershed and coastal nitrogen dynamics; environmental effects; and management. He has emphasized a multimedia approach in these endeavors, linking airshed and watershed sources into comprehensive analyses and management efforts. Having served on a number of EPA, NOAA and ASIWPCA workgroups to define and establish policy and criteria for nitrogen, most recently as an invited participant in an EPA effort to define critical loads of nitrogen and acidifying compounds, Mr. Stacey is expert in programs and policies related to nitrogen control in an integrated protocol. Connecticut has implemented the most extensive nitrogen-trading program in the country, essential to the success of a bi-state management plan (TMDL) for nitrogen, efforts in which Mr. Stacey has played prominent roles. He is responsible for formulating Connecticut's risk-based dissolved oxygen criteria, necessary to effective management of nitrogen enrichment in LIS. Further, his long-standing positions on the Scientific and Technical Advisory Committee for the LISS and as a technical reviewer for state and federal research funding programs have involved him in research programs that have improved nitrogen understanding and control.

He is a member of the Estuarine Research Federation and its Program Advisory Council for ERF 2007; the Water Environment Federation; and the New England Estuarine Research Society. Mr. Stacey has been honored with distinguished service awards from CTDEP and the Governor, and was a lecturer in the Curtis and Edith Munson Distinguished Lecturer Series at Yale University. He sits on the New England Governors and Eastern Canadian Premiers Acid Rain Steering Committee and the Interstate Environmental Commission. He regularly presents at professional conferences on nitrogen management and the LIS ecosystem and has produced technical publications on trading, monitoring and atmospheric deposition of nitrogen including co-editorship of a Coastal and Estuarine Studies volume for the AGU. In the last five years Mr. Stacey has served on over a dozen advisory committees including projects for the Water Environment Research Foundation, the Hubbard Brook Research Foundation, and the Institute of Marine Sciences in Lisbon on projects related to nitrogen dynamics and management, setting

feasible management goals and defining effective management tools. Mr. Stacey is responsible for extensive monitoring programs for the LISS and the National Coastal Assessment. He has been awarded special funding for projects to develop a nutrient watershed model in Connecticut (completed), to establish nitrogen criteria for the protection of eelgrass beds (current), and to assess Connecticut's nitrogen trading program and evaluate its potential for expansion (completed).

Ephraim King, Former Director, US EPA Office of Science and Technology

Ephraim King is a national expert on the development of public policy and regulatory requirements under the Clean Water and Safe Drinking Water Acts. He has over 32 years experience with the U.S. Environmental Protection Agency in working with scientists, state leaders, and stakeholders across the country in applying peer-reviewed research, cutting edge technology, quantitative assessment, economic analysis, and national environmental data to support state and national water program implementation.

As the Director of the Office of Science and Technology (2005-2011) Mr. King led the development of water quality policy, technical guidance, science-based water quality criteria, best management practices, technology-based effluent guidelines, and drinking water public health criteria. Prior to OST, he was a Division Director and Branch Chief in the Office of Ground Water and Drinking Water (years?) and Chief of the National Pollutant Discharge Elimination System (NPDES) State Programs Branch (1987 to 1996). He also served in the Administrator's office and General Counsel's office (1979 to 1986). In 2011 he retired from US EPA.

Mr. King holds a B.A. degree from Harvard University and a J.D. from the University of Maine School of Law. He now provides policy and program implementation advice in the areas of regulatory and non-regulatory tools, water quality, fracking, and nutrients.

Item 4 – Three Topic-Specific White Papers (Chris Foe's Presentation)

Revised Agenda

Item #1 Introductions & Announcements

Item #2 Background

- Delta Nutrient Study Plan (Chris Foe)
- San Francisco Bay Nutrient Studies (David Senn)
- Delta RMP Nutrient Monitoring Subcommittee (Thomas Jabusch)
- Statewide Nutrient Numerical Endpoint Program (Martha Sutula)

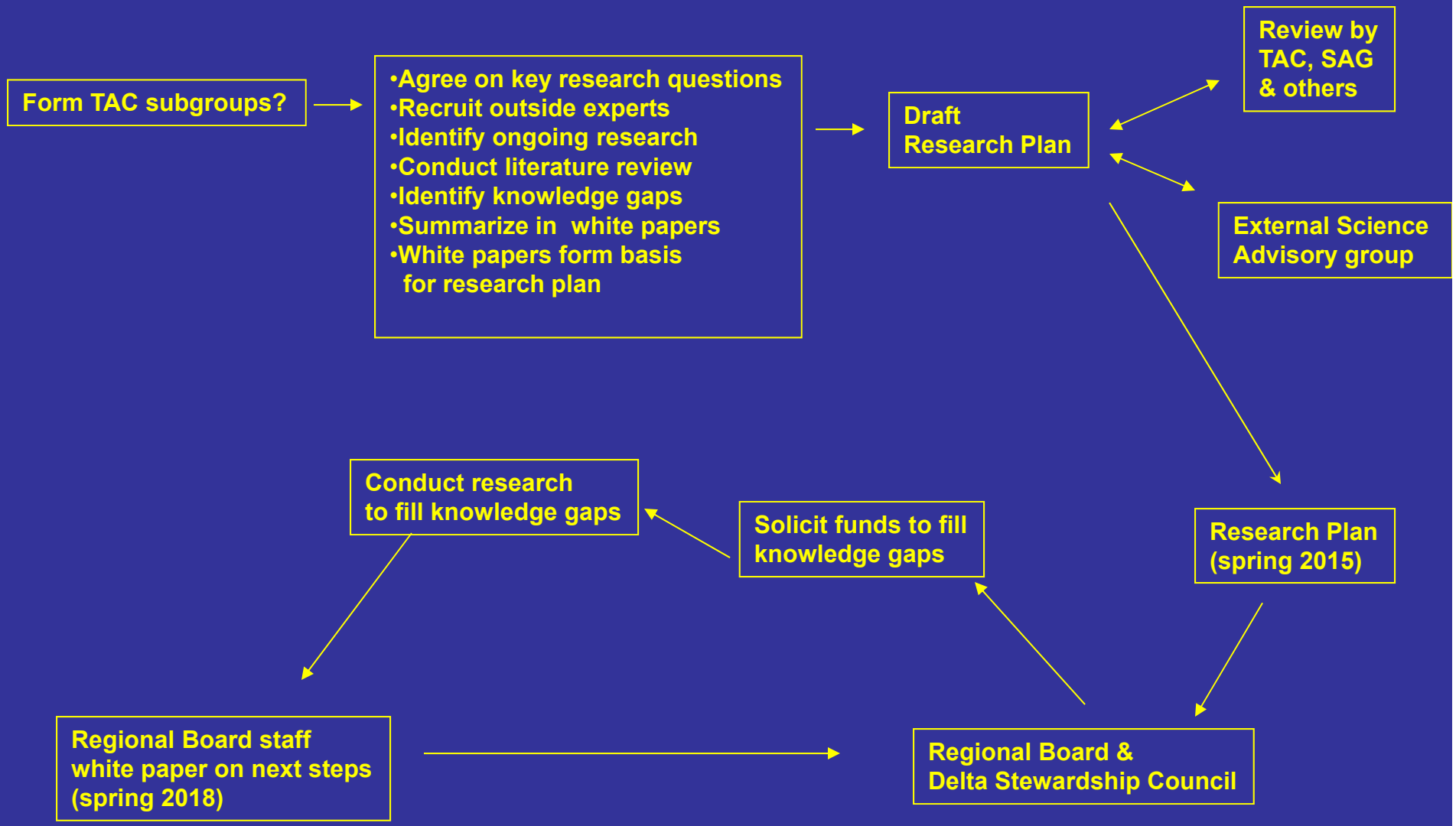
Item #3 Lunch Break

Item #4 Topic specific issues

- Overview (Chris Foe)
- Shifts in abundance and composition of algal community (Chris Foe)
- Cyanobacteria white paper outline (Mine Berg)
- Rooted and Floating Macrophyte white paper outline (Kathy Boyer)

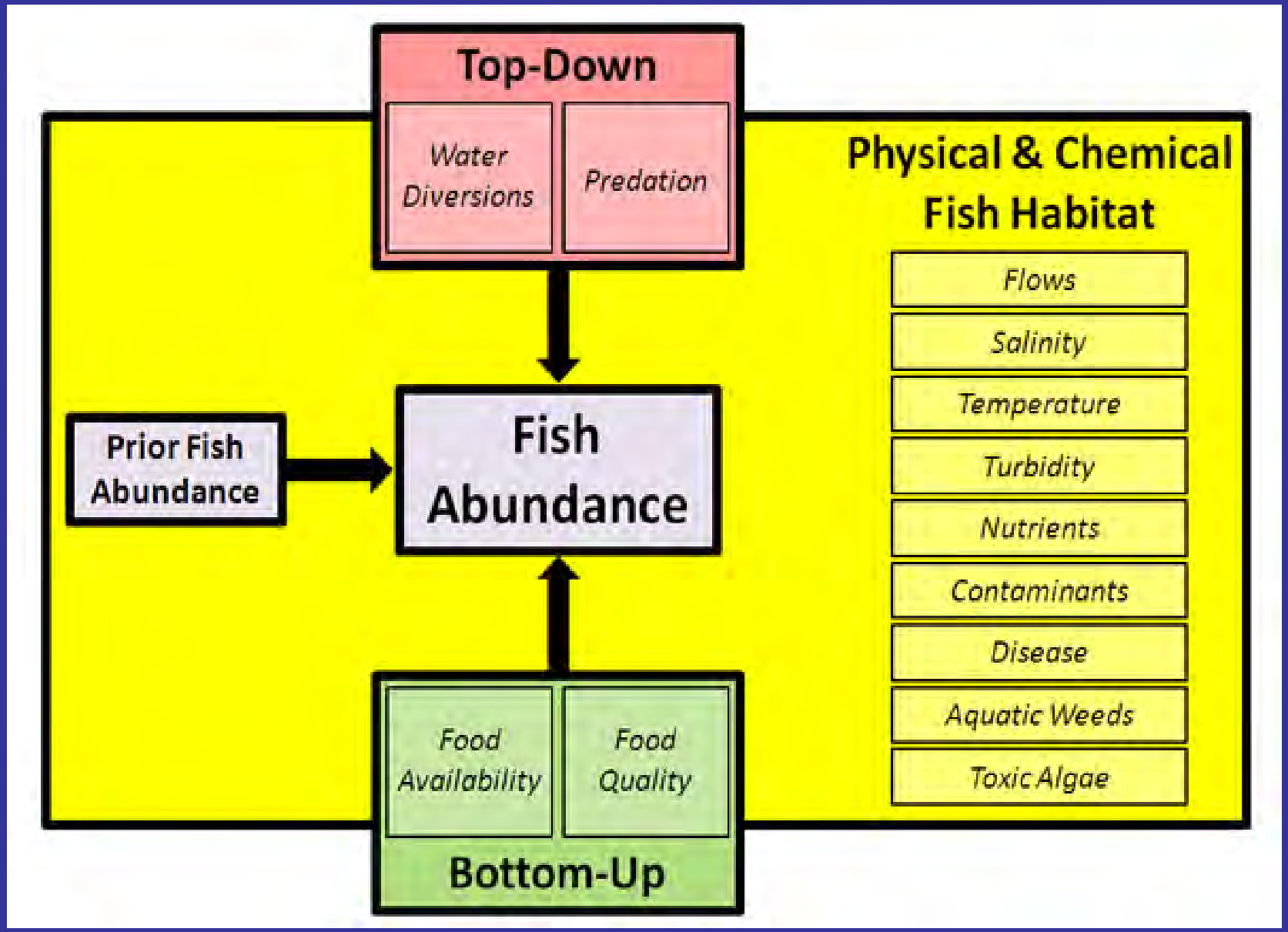
Item #5 Wrap up

Strawman for developing & implementing research plan



Issue #1: Shifts in abundance and composition of algal community

- Decrease in primary production rates & algal biomass.
- Shift in algal community composition



From: Sommer *et al.* 2007

Shifts in nutrient forms, concentrations and ratios

- Increase in dissolved inorganic nitrogen, decrease in PO4, and an increase in N:P ratio.

Hypothesis: Shift in nutrients responsible for the change in algal species composition & decrease in primary production rates

- Mechanisms:
  - Ammonium paradox
  - N:P ratios

Phytoplankton/Nutrient Computer Model

- Biotic and abiotic changes have & will continue to occur in the Bay-Delta Estuary.
- Computer model is needed to predict & understand impact of changes at base of food web
- A number of potential models exist that might be a suitable
- Convene a portion of TAC to make recommendations on model selection.

Summary

- White paper on whether nutrients cause/contribute to decrease in algal abundance and to change in species composition.
- Develop criteria for computer model selection.
- Board staff will assume responsibility for writing both issue papers but need input from TAC.
- White papers would form basis for research plan

Questions for the group

- Have I captured the major hypotheses?
- How should we organize the group to work on the two issues? Subgroup, whole group…?
- Who needs to be recruited to the group that is not present?
- Who has ongoing unpublished research?
- Are there new grey literature or peer reviewed papers?

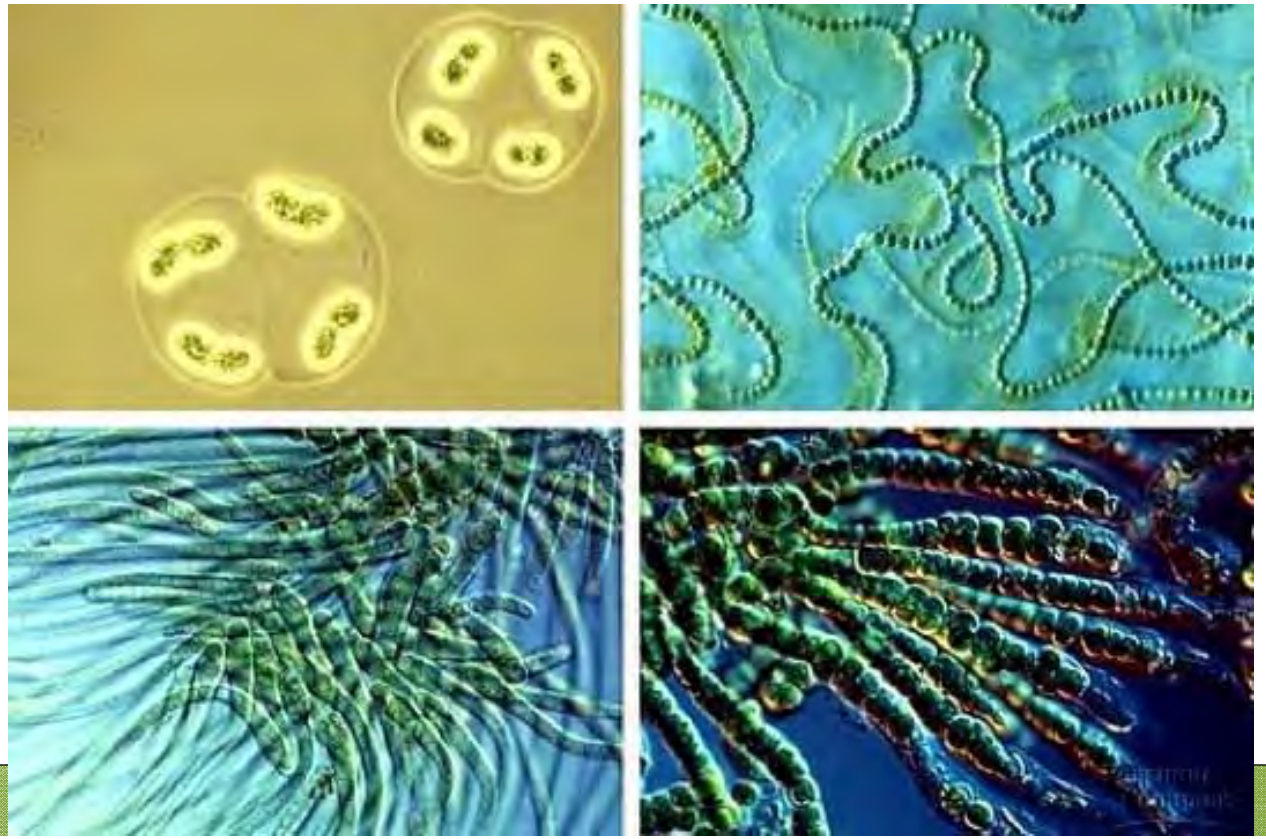
Item 4 – Three Topic-Specific White Papers
(Mine Berg's Presentation & White Paper Outline)

Factors Affecting Growth of Cyanobacteria

With special emphasis on the San Francisco Bay-Delta region

Mine Berg, Applied Marine Sciences

Goal: provide context for interpreting cyanobacterial growth dynamics in the Delta



Key Questions to be addressed by review:

- What are the spatial and temporal trends in cyanobacterial dominance and/or cyanotoxin concentrations in the San Francisco Bay Delta (Delta)?
- What is the relative importance of nutrients versus other factors in promoting cyanobacterial dominance in the Delta? How does this compare with other estuarine systems?
- What are the key data gaps and recommended future studies?

Review Outline

- Executive Summary
- Introduction: Purpose of Review and Key Questions
- **Biological characteristics and ecological factors that promote or inhibit cyanobacteria in freshwater/estuarine environments**
  - Biological Characteristics
    - Photosynthesis/pigments
    - Nitrogen fixation
    - Regulation of nutrient uptake and assimilation
    - Toxin production
  - Factors that influence ecology of cyanobacteria (including examples from other systems)
    - Temperature
    - Nutrient concentrations and forms
    - Water column stability/mixing
    - Water clarity
    - Irradiance
    - Salinity
- **Ecology and spatio-temporal trends of cyanobacteria in the Delta**
  - Overview of cyanobacterial ecotypes occurring in the Delta
  - Spatial and temporal patterns of cyanobacterial blooms in the Delta
    - Distributions of ecotypes along the salinity gradient
    - Seasonal occurrences
    - Summary of cyanotoxin concentrations
- **Synthesis of factors potentially contributing to development of cyanobacterial blooms in the Delta**
  - How do cyanobacteria impair beneficial uses in the Delta region?
  - What is the relative importance of nutrients versus other factors in promoting harmful cyanobacterial blooms and impairment of beneficial uses?
  - Extent of scientific consensus on this issue
- Summary of key data gaps and recommended studies

Time Line

- Fleshed-out outline: end of June
- Biological and Ecological characteristics section: end of July
- Spatial temporal trends of cyanobacteria in the Delta section: end of August
- First Draft due: September
- Final Draft (including incorporation of comments) due: October

Cyano Review Outline Berg+ Sutula /05152013

Questions to address in the review:

1. What is the relative importance of nutrients versus other factors in promoting cyanobacteria dominance and/or cyanotoxin production in aquatic ecosystems globally?
2. What are the spatial and temporal trends in cyanobacteria dominance and/or cyanotoxin production in the Delta?
3. What is the relative importance of nutrients versus other factors in promoting cyanobacteria dominance and/or cyanotoxin production in the San Francisco Bay-Delta?
4. What are the key data gaps and recommended future studies?

Review Outline

1. Executive Summary
2. Introduction, Purpose of Review, and Key Questions
3. Ecology of Cyanobacteria
    a. Basic photophysiology (pigments, light capture, photosynthesis)
    b. Nitrogen fixation
    c. Toxin production
    d. Cyanobacterial ecotypes
        i. Filamentous
        ii. Unicellular
        iii. Freshwater
        iv. Marine/Estuarine
        v. HABs
4. Ecological Characteristics that promote cyanobacteria in Freshwater/estuarine environments (emphasis on mechanistic description of how factors promote blooms/toxic production)
    a. Temperature
    b. Nutrients
    c. Water column stability/mixing
    d. Water clarity
    e. Irradiance
    f. Others…
5. Factors contributing to development of cyanobacterial blooms in the San Francisco Estuary-Delta region
    a. Summary what species are found, their physiological tolerances along a fresh-marine continuum
    b. Summary of spatial and temporal patterns in cyanobacterial blooms and cyanotoxins concentrations
    c. Relative importance of nutrients versus other factors in controlling cyanobacterial dominance
    d. Summary of key data gaps and recommended studies

06/03/2014 Review Outline from PowerPoint Presentation

- Executive Summary
- Introduction: Purpose of Review and Key Questions
- **Biological characteristics and ecological factors that promote or inhibit cyanobacteria in freshwater/estuarine environments**
    - Biological Characteristics
        - Photosynthesis/pigments
        - Nitrogen fixation
        - Regulation of nutrient uptake and assimilation
        - Toxin production
    - Factors that influence ecology of cyanobacteria (including examples from other systems)
        - Temperature
        - Nutrient concentrations and forms
        - Water column stability/mixing
        - Water clarity
        - Irradiance
        - Salinity
- **Ecology and spatio-temporal trends of cyanobacteria in the Delta**
    - Overview of cyanobacterial ecotypes occurring in the Delta
    - Spatial and temporal patterns of cyanobacteria blooms in the Delta
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        - Summary of cyanotoxin concentrations
- **Synthesis of factors potentially contributing to development of cyanobacterial blooms in the Delta**
    - How do cyanobacteria impair beneficial uses in the Delta region?
    - What is the relative importance of nutrients versus other factors in promoting harmful cyanobacterial blooms and impairment of beneficial uses?
    - Extent of scientific consensus on this issue
- Summary of key data gaps and recommended studies

Item 4 – Three Topic-Specific White Papers
(Kathy Boyer's Presentation & White Paper Outline)

Submerged and Floating Macrophyte Review

Kathy Boyer, Romberg Tiburon Center, SF State

How might nutrients, relative to other factors, influence patterns and trends in weedy invasive macrophyte species?

Invasive *Egeria densa* in the Delta

Questions to address in the review:

- What are the general conceptual models of rooted or floating aquatic vegetation in relation to both impacts to and support of beneficial uses?
- What is known about the spatial and temporal trends in floating and rooted aquatic vegetation in the Delta?
- What is the relative importance of nutrients and organic matter accumulation versus other factors in promoting observed trends in floating and rooted aquatic vegetation in the Delta?
- What are the key data gaps and recommended future studies?

Review Outline

- Executive Summary
- Introduction, Purpose of Review, and Key Questions
- General Ecology and Trends in the Distribution of Floating and Rooted Aquatic Vegetation in the Delta
  - Definitions
  - Overview of genus/species found in the Delta
  - Habitat types in which they are characteristically found
  - Spatial and Temporal trends in their distribution and abundance
- Conceptual models of linkage with beneficial uses (if there is a problem—what is it?)
  - General conceptual model
    - Organic matter subsidy/accumulation
    - Limitation of phytoplankton and native SAV
    - Trophic support
    - Habitat alteration
    - Navigation and industry
    - Aesthetics
  - Documentation of adverse effects in the Delta
- Factors contributing to spread of floating and rooted aquatic vegetation in the San Francisco Estuary-Delta region
  - Conceptual models of growth, propagation and environmental characteristics that enhance or limit growth
  - Relative importance of nutrient subsidies versus other factors in promoting observed trends
- Summary of key data gaps and research needs

Approach:

Synthesis of existing literature; e.g.:

- BDCP, Conservation Measure 13 – control of invasive aquatic vegetation
- BDCP (Appendix 5F – Biostressors) -- discusses invasive aquatic vegetation
- DRERIP Conceptual Model for Aquatic Vegetation – Lars Anderson 2008
- CA Dept of Parks and Rec, Division of Boating and Waterways web page & reports
- NPDES permits for DBW spray program for aquatic weeds, notice of intent for *Egeria densa*
- "Water hyacinth – Can its aggressive invasion be controlled?" UNEP Global Environmental Alert Service
- K. Boyer reports to Delta Science Program and CALFED ERP on distribution and abundance of submerged and floating veg

Interviews to assess active, unpublished work:

- John Durand dissertation, *E. densa*
- Susan Ustin and Shruti Khanna mapping, Erin Hester dissertation

Suggestions???

Timeline:

Fall 2014: Intensive effort
Late December: Distribute draft
Late January: Submit final version

Rooted and Floating Macrophyte Review Outline
05-21-2014 Draft

Katharyn Boyer (SFSU) and Martha Sutula (SCCWRP)

Questions to address in the review:

1. What are the general conceptual models of rooted or floating aquatic vegetation in relation to both impacts to and support of beneficial uses?
2. What is known about the spatial and temporal trends in floating and rooted aquatic vegetation in the Delta?
3. What is the relative importance of nutrients and organic matter accumulation versus other factors in promoting observed trends in floating and rooted aquatic vegetation in the Delta?
4. What are the key data gaps and recommended future studies?

Review Outline

1. Executive Summary
2. Introduction, Purpose of Review, and Key Questions
3. General Ecology and Trends in the Distribution of Floating and Rooted Aquatic Vegetation in the Delta
    a. Definitions
    b. Overview of genus/species found in the Delta
    c. Habitat types in which they are characteristically found
    d. Spatial and Temporal trends in their distribution and abundance
4. Conceptual models of linkage with beneficial uses (if there is a problem—what is it?)
    a. General conceptual model
        i. Organic matter subsidy/accumulation
        ii. Limitation of phytoplankton and native SAV
        iii. Trophic support
        iv. Habitat alteration
        v. Navigation and industry
        vi. Aesthetics
    b. Documentation of adverse effects in the Delta
5. Factors contributing to spread of floating and rooted aquatic vegetation in the San Francisco Estuary-Delta region
    a. Conceptual models of growth, propagation and environmental characteristics that enhance or limit growth
    b. Relative importance of nutrient subsidies versus other factors in promoting observed trends
6. Summary of key data gaps and research needs